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A study of institutionalized educable mentally handicapped children (EMR's aged 6-7 to 12-6) was designed to evaluate the use of subtest combinations and learning tasks as predictors of achievement compared to single individual and group tests. Fifty-one subjects received a pretest battery of six individual tests, one group test, three learning tasks, and the criterion achievement measures of three subtests from the Wide Range Achievement Test (WRAT) and the New York Achievement Test (NYAT). After 7 months the learning tasks, WRAT, and NYAT were readministered. Results indicated that overall achievement of young institutionalized EMR's will be predicted with higher validity both by a combination of the Auditory-Vocal Association and Auditory-Vocal Automatic subtests from the Illinois Test of Psycholinguistic Abilities, the Picture Vocabulary subtest from the Pictorial Test of Intelligence, and the Number Facility and Perceptual Speed subtest from the Primary Mental Abilities Test (correlation coefficient=.779), and by a regression equation developed from a multiple regression analysis of selected subtests than by any single individual or group test. The better predictors of achievement for the oldest group were subtests which can be administered to groups; individually administered tests were better predictors at younger ages. (RP)

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September 1968

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Chapter I

INTRODUCTION

The movement to develop special classes for the mentally retarded was initiated around 1900 with the assumption that the educational setting, as part of the social environment of the child, influences the rate and nature of intellectual development. During this time the special education movement was impeded by the impressive naturistic writings of Galton (1869), J. McK. Cattell (1890), and Goddard (1912). Such writings contended that intelligence was fixed at birth and not amenable to change.

The impetus for the establishment of special classes for the retarded was given by the work of Alfred Binet. Binet regarded as pessimistic the conception that intellectual development was completely determined by heredity. (Goldstein, Moss, and Jordan, 1965) The Binet-Simon test of intelligence made possible an objective intellectual assessment of children and an evaluation of their educability. Since the early 1900's the number of children evaluated for special schools and classes has increased markedly. In 1963 324,000 children were enrolled in special classes in public schools (La Crosse, 1964) and 284,000 under twenty years of age were in institutions. (Hunter, 1964)

Thus, the number of school aged children placed in residential schools has increased steadily in the past decade. With the increase has been a concomitant change in the philosophy of the residential school from a terminal placement to a temporary placement, particularly with children who are educable. The emphasis on rehabilitation or habilitation to the community has focused attention on the need and development for educational programs. Presently the number of children eligible for existing educational programs is too large to accomodate all. Since many culturally deprived children are included in institution populations, more systematic procedures are needed for prediction of learning potential of all children in institutions. The shortage of special teachers also makes it imperative that those children who can succeed in such a program be selected. Those who cannot succeed will require a different type of program utilizing different educational techniques and objectives. Therefore, the procedure for the selection of children for special classes becomes crucial in order that those who may benefit most from an educational placement be identified. While recent investigators have concerned themselves with the efficacy of special classes, the selection and procedure for the placement of children in the classes remains inconclusive.

Since the beginning of the testing movement, one of the primary criteria for the placement of children in special schools and classes has been a low score on an intelligence test. The function of such a test is to predict the learning ability of a child so that he may receive an educational program appropriate to his ability and rate of development. The effectivemess of such placement and educational program depends largely upon the validity of the test or tests used to measure the functioning level of the child and to predict the rate of expected development. The need for an investigation of the validity and predictive power of tests used with the mentally retarded is a crucial one.

The role of the psychologist, in a psychological assessment, is to determine the eligibility of a child for educational placement and offer a prediction as to the probability of success. The basis for prediction in the past has been the demonstration of the relationship between intelligence measures, learning, and achievement. Individual tests have been used routinely but little attention has been given to the use of test and subtest combinations or to the factors related to learning by young educable mentally handicapped children. With the advent of new tests for use with young children, the use of factorial information and test combinations should improve the validity in the prediction of learning and achievement.

Studies by Kirk (1954) and Goldstein, Moss, and Jordan (1965) indicate a growing trend to place educable mentally retarded children in special classes at earlier ages. But currently used tests have demonstrated limited utility with the young, educable mentally retarded. With the development of psychometric measures for use with younger children, the need to establish the validity and predictive effectiveness of each test or combination of tests is clear. If such measures are to be used as the primary criteria for placement in a special class, the degree to which they are effective can only be determined by establishing their validity on the population whose learning ability is to be predicted. The combination of tests utilized as a battery must also be investigated for the same purpose.

The relationship of psychometric measures to achievement needs continuing refinement and evaluation. Some researchers have demonstrated the utility of learning task performance to predict the achievement level of the retarded. Such learning tasks, requiring the subject to demonstrate learning as part of the task, suggest utility as brief measures which conserve the time of psychologists. Such measures, however, require further study. Recent factor analyses have indicated verbal ability, number ability, and perceptual ability to be the primary components of learning for educable mentally retarded youth. Various tests and subtests have demonstrated high relationships with measures of the above abilities suggesting that the improved prediction of achievement can be realized through a combination of these related measures. The rationale for the selection of specific subtests proposed in the hypothesis will be presented in the review of the literature.

As shown, suitability and probable success for a child placed in a special program is partly dependent upon the validity of the psychometric measures used to determine the placement. If a psychometric instrument or combination of instruments or subtests can be demonstrated to predict the learning ability and achievement with a high degree of validity, improved placement would result. Further, the time of teachers, psychologists, and students could be better utilized as a result of quick, reliable selection procedures.

Purpose of Study

The purpose of this investigation was to evaluate the use of subtest combinations and learning tasks as predictors of overall, arithmetic, and reading achievement when compared to single individual and group tests. Another purpose of this study was to determine the effects of age upon the predictive validities of the predictor tests. The study was also designed to determine the best predictors of overall achievement for institutionalized educable mentally retarded children (EMR's).

Hypotheses Investigated

Hypothesis I: Overall achievement of young institutionalized EMR's, IQ 50-75, will be predicted with a higher validity by a regression equation based on the combination of the Auditory-Vocal Association and Auditory-Vocal Automatic subtests from the Illinois Test of Psycholinguistic Abilities (ITPA), the Picture Vocabulary subtest from the Pictorial Test of Intelligence (PTI), and the Number Facility and Perceptual Speed subtests from the Primary Mental Abilities Test (PMAT), (CPS1), for all age levels, than by any single individual or group test.

Corollary I: The combination of subtests described in Hypothesis I will demonstrate higher predictive validity with the 6-7 to 8-6 year level (Age Group One) than with the 8-7 to 10-6 (Age Group Two) or 10-7 to 12-6 year (Age Group Three) levels.

Hypothesis II: Arithmetic achievement of young institutionalized EMR's, IQ 50-75, will be predicted with a higher validity by a regression equation based on the combination of Auditory-Vocal Association (ITPA), Size and Number (PTI), Arithmetic (Wechsler Preschool and Primary Scale of Intelligence, WPPSI). and Number Facility (PMAT), (CPS2), than by any single individual or group test.

Hypothesis III: Reading achievement of young institutionalized EMR's, IQ 50-75, will be predicted with a higher validity by a regression equation based on the combination of Auditory-Vocal Association and Visual-Motor Sequential (ITPA). Form Discrimination (PTI), and Number Facility, (CPS3), for all age levels, than by any single individual or group test.

Hypothesis IV: Overall achievement of young, institutionalized EMR's, IQ 50-75, will be predicted with higher validity by a regression equation based on a combination of subtests in Hypothesis I than by the Coding (Wechsler Intelligence Scale for Children, WISC), Paired Associate Task (PAT), and Order Learning Tasks (OLT) combined (CLTS).

Hypothesis V: Overall achievement of young institutionalized EMR's, IQ 50-75, will be predicted with higher validity by a regression equation developed from a multiple regression analysis of selected subtests than by any single individual or group test.

Definition of Terms

Educable Mentally Retarded (EMR) are those children whose intelligence quotients on a test of intelligence, individually administered by a qualified psychologist was reported to be between 50 and 75 during the year prior to the study and whose chronological age (CA) was between 6-7 and 12-6. The individually administered tests were comprised of the Stanford-Binet, Pictorial Test of Intelligence, and the Wechsler Intelligence Scale for Children.

Predictor Measures are six individually administered tests, one group test, and three learning tasks yielding test scores evaluated in the analysis. They were: (1) The Stanford-Binet Intelligence Scale, Form LM (S-B, Terman and Merrill, 1960); (2) The Illinois Test of Pyscholinguistic Abilities, Experimental Edition (ITPA, McCarthy and Kirk, 1961); (3) The Pictorial Test of Intelligence (PTI, French, 1963); (4) The Wechsler Preschool and Primary Scale of Intelligence (WPPSI, Wechsler, 1967); (5) The Quick Test (QT, Ammons and Ammons, 1962); (6) The Slosson Intelligence Test for Children and Adults (SIT, Slosson, 1963); (7) The Primary Mental Abilities Test (PMAT, Thurstone and Thurstone, 1962). Further descriptions are set forth in Appendix A.

Learning Tasks are three predictor measures requiring the subject to demonstrate learning as part of the presented task. They were: (1) Coding A (Wechsler, 1949); (2) Paired Associate Task (PAT); (3) Order Learning Task (OLT). Further descriptions are set forth in Appendix A.

Achievement Criterion Measures are the averaged test results of three individually administered achievement measures of reading, arithmetic, and spelling from The Wide Range Achievement Test (WRAT, Jastak and Jastak, 1965) and the three group administered achievement measures of reading, arithmetic, and core skills from the New York Achievement Tests (NYAT, Wrightstone, et. al.; 1959). Further descriptions are set forth in Appendix A.

Limitations

The representativeness of the sample is an important limitation in that the results of this study can only be generalized to groups similar to the particular group studied. Generalizations can be made from this study to the extent that the sample does not significantly differ from other institutional populations.

In particular there is a limitation dealing with the generalization of the results to populations not having been exposed to an educational program. The population studied had been enrolled in an educational program; therefore, generalization of the findings can be made only to similar groups.

The degree to which the achievement criteria measures the academic achievement and objectives of the educational programs must be regarded as another limiting factor in the study. A correlate to this limitation is that no attempt was made to control the content in the educational program during the study.

In this chapter the need for further investigation of psychometric assessment procedures with institutionalized children was stated. The evaluation of varied methods of predicting learning potential was proposed in the stated hypotheses. The following chapter will include a review of the related literature to support the investigation.

Chapter II

REVIEW OF LITERATURE

The review of the literature presented is divided into the areas of prevalence of institutionalized youth, the relationship of mental measures and learning, intelligence measures and achievement with noninstitutionalized and institutionalized children, language tests and achievement of retardates, group tests and achievement of retardates, factorial analyses of test data, and age effects on predictive studies with the mentally retarded.

Prevalence of Institutionalized Youth

Provisions for the mentally retarded have existed in various forms since 1857 when Dr. Samuel H. G. Howe inaugurated the concept of the residential training center for the retarded. This concept gained in popularity as many states adopted the plan for training the retarded. It was not until almost fifty years later that the first public school special class was opened.

An increase in the number of institutionalized retarded has contributed to the general concern for the proper care and education of the institutionalized retardate. Of an estimated 5,000,000 retarded individuals in the United States (Benda, 1958; The President's Panel on Mental Retardation, 1962), Benda reports 150,000 as being institutionalized; the President's Panel estimates 210,000; and

Tarjan (1967) provides a figure of 200,000 as the number of retarded individuals in American institutions.

Recent prevalence figures indicate a steady increase in the number of school age children in residential institutions. In 1958 Benda estimated 30,000 to 50,000 educable mentally retarded persons in institutional settings. In a survey of residential school programs six years later Hunter (1964) reported 284,000 children under the age of twenty in residential schools. Scheerenberger (1965) found nearly half of the retarded in institutions to be under twenty and half of the new admissions to be placed before the age of ten. Approximately 67 percent of residential placements are children under 15 years of age. (The Presedent's Panel, 1962) The number of children below the median age of 11 at the time of placement indicates the need for educational programs.

Tarjan (1966) states that even though the school aged retardate will spend considerable time in residency he should not remain in a residential facility any longer than necessary but instead should return to the community. Such a philosophy and goal was proposed also by Hegge in his 1956 address to the national convention of The American Association on Mental Deficiency. Hegge stated that "all aspects of residential planning: philosophy, staff, curricula, work experiences, should be directed to this goal." The President's Panel on Mental Retardation (1962) recommended that philosophies, objectives, and goals should enable qualified institutionalized retardates to return to productive community life. The panel also stated that:

> The true goal of education and rehabilitation of the handicapped is to help every individual to make the most of his potential for participation in all affairs of our society, including work, no matter how great or small his potential may be. It is the obligation of public and private education to provide appropriate educational opportunities for all mentally retarded children who can profit from education and training.

The need for educational programs in order that the charge of the President's Panel be fulfilled becomes evident. The assessment of "potential" and the providing of "appropriate educational opportunities" implies a complex selection process. Benton (1964) states that the purpose of the psychological evaluation is "to determine whether or not an individual should be classified in the broad category of the mentally retarded and to make a prognostic evaluation in respect to course of development and response to special educational, psychotherapeutic, or physiotherapeutic measures." Mueller (1965) suggested that the effectiveness of such a selection for placement and assignment to a treatment depends largely upon the validity of the test used in measuring the level at which a child is functioning and predicting the rate at which he can be expected to progress.

The decision as to whether a child should profit from special class placement presents many problems to school psychologists and educators. Such problems appear to be related to: (1) the validity of psychological evaluation, and (2) the validity of the IQ in predicting future educational growth. (Holowinsky, 1960)

This trend toward the rehabilitation of institutionalized children to the community indicates a need for expanded educational programs in the institutional setting. It is through such programs that the child is prepared to return to the community. However, at present the number of children exceeds the available educational space. With an increase in the number of school aged institutionalized children, and with too few educational classes to accomodate all, the validity of procedures and measures used in the selection of children requires further study. Also the length of time involved in the education of institutionalized youth indicates a need to develop accurate predictors of learning.

Mental Measures and Learning

The literature related to the constancy of IQ and validity of psychological evaluations in predicting academic achievement is large and complex. Studies indicative of the relationship between IQ and educational achievement by Bradway (1945), Collier (1953), Keys (1960), and Lennon (1950) are a few of those reported. Increased attention has been given to the relationship between psychometric measures and educational achievement with the mentally retarded. Reviews by Baumeister (1964), Clarke and Clarke (1958), Miller (1960), and Mueller (1964) include many studies related to the predictive validity of numerous psychometric instruments with mentally handicapped populations.

Anastasi (1961) stated that the validity of intelligence tests is most commonly determined by the correlation with measures of academic achievement or with previously established tests of intellectual ability. Advocating another approach, Little (1960), and later Gallagher (1963) proposed a strong need for test constructors to establish an instrument's validity "directly on the group on which it will be used rather than on another test." Gallagher further stated that such a test should demonstrate its "usefulness" by predicting some school or academic performance of the designated reference group. Denny (1964) suggested the use of learning tasks as a possible criterion measure for the validation of a psychometric test or process oriented method of assessing intelligence.

Conclusions concerning the prediction of academic achievement focus generally upon the validity of an instrument with the specific population and a trend toward parsimonious measures. The advent of learning tasks and rapid screening devices are indicative of a need for a general review of the relationship of intelligence measures and achievement.

Implications from the assessment of intelligence has generated much controversy. Simrall (1947) stated that intelligence tests measured learning ability. He further proposed that it was not considered necessary for an intelligence test to sample future learning since it is assumed that what an individual has learned in the past is a valid predictor of what he can learn in the future. McGeoch and Irion (1925) stated that the right of test constructors to make such an assumption about the predictive value of past learning rests upon certain other assumptions. McGeoch and Irion describe these assumptions: first, intelligence tests assume that all persons tested have equal opportunity to learn the materials which are used in the test; and second, that even though persons have had equal opportunity to learn the materials, they have not learned it to the same degree. As a result differences which appear in test scores are a reflection of differences in intellectual ability.

Criticism of this approach was leveled by Woodrow (1946) who demonstrated a lack of correlation between intelligence test scores and learning measured by gains due to practice, even though intelligence was positively correlated with achievement at different stages of practice. Woodrow stated that achievement is due partly to maturational and hereditary factors and it can never be attributed solely to learning. Measures of school learning were sought by Woodrow (1945) in a study of the gains of elementary pupils in six school subjects over a one and over a three year period. He found that the correlation between intelligence and achievement reached its maximum rather early in the school grades and that there was lack of significant relation beyond the fifth grade. Woodrow (1946) further concluded that there was no general factor to determine rate of improvement in widely different test performances, and that learning seemed more related to group and specific factors.

It was shown that increasing the number of measures to be related with intelligence produced a rise in correlation. Garret (1928) administered eight tests of memory and learning to 200 students. By pooling the tests of memory and learning, an increase in correlation with intelligence from .21 to .60 was realized. Garret concluded "that measures of memory and learning are substantially related to reliable measures of intellect provided enough different measures can be pooled together."

De Weerdt (1927) found that the use of learning was a more appropriate and direct method for investigating capacity for improvement in a specific function rather than the use of inference from a general ability test. He administered seven practice tests (subtraction, addition, reading, cancellation, multiplication, same-opposite, multiplication by subtraction) to 45 fifth grade children for eleven days. There were specific gains in all subjects. He conceded a possible relation between capacity for improvement and general ability, but could not indicate how much improvement to expect in a specific situation.

In a review of intelligence and the ability to learn, Rapier (1962) states that the over reliance on one administration of a single test of intelligence has never been satisfactory and that either more measures or repeated measures provide a more stable base upon which to evaluate performance.

In view of the reported studies the relationship between test scores and learning measures continue to be unclear and subject to many complex factors.

Intelligence Measures and Achievement of Retardates

Traditionally, intelligence tests have been used to determine the educational placement of the mentally retarded. The function of an intelligence test is to predict the learning ability of a child in an educational program. The use of intelligence tests as achievement predictors with institutionalized and noninstitutionalzed educable mentally retarded populations have been reported in many studies.

Noninstitutionalized Retardates

Sandercock and Butler (1952) correlated the WISC IQ's with school achievement quotients in reading, arithmetic, and social studies for ninety defectives, ranging in age from 10 to 16. The Achievement Quotient was derived from judgments of the child's academic progress relative to his age. Positive correlations were found to be significant with V IQ being the best predictor with a correlation of .61 to the achievement criterion. WISC FS scores reached a correlation of .57 with the achievement measures.

In a similar study of 62 educable mentally retarded children placed in special classes, Kimbrell (1960) found a correlation of .40 between grade placement and mental age scores derived from the WISC. Such a relationship would not be unexpected since even among retardates there must be some relationship between mental age and chronological age which would be reflected in grade placement.

McCullough, Reswick, and Roy (1955) analyzed the performance of subnormals on learning word lists presented by tape recorder. Each list, increasing in length from two to nine words, was presented five times, and followed each time by the subject's attempt to repeat it. Measures of learning were grasp (initial) score and gain score correlated with mental age. Total score was positively related to mental age. The authors interpreted the results as demonstrating a difference in abilities required for one-trial learning measured by grasp and repetitive learning measured by gain.

In another experiment by McCullough, Reswick, and Weismann (1955) correlations were obtained between a measure of the Word Learning Test with three other measures, Digit Repetition, S-B, and the WISC. Subjects were one hundred subnormals with a mean mental age of 8-4. The rather low correlations demonstrated some support for the hypothesis that grasp would correlate more highly than gain with the mental measures.

Wolfensberger (1962) attempted to further determine the relationship between the Peabody Picture Vocabulary Test (PPVT) and the WRAT scores. Results of testing with 61 mentally handicapped subjects ranging in IQ from 16 to 82 yielded PPVT correlations of .52 with reading, .33 with spelling, and .35 with arithmetic. All correlations were significant at the .01 level. Mueller (1964) in a review reported that there is some evidence that the S-B is superior to the PPVT in predicting reading and writing achievement and the validity of the PPVT appears to be generally unproven, indicating further the complexity of the relationships between test scores and achievement.

In an investigation evaluating the S-B, ITPA, PPVT, PTI, Colored Progressive Matrices (CPM), and PMAT as predictors of achievement, Mueller (1965) reported that two tests, the S-B and the PMAT, could optimally predict the performance of EMR's. The sample of 101 EMR's whose CA's ranged from 7 to 11 years were used as subjects for the study. The criterion tests were the WRAT, the NYAT, Coding subtest of the WISC, a simple alternating task, a paired associate task, and a modified reading test. Validity coefficients for total predictor test scores reported against criterion measures were: PMAT, .79; S-B, .76; PTI, .71; ITPA,.69; CPM, .50; PPVT, .42. The PMAT, S-B, ITPA, and PTI had significantly higher validity than the CPM and PPVT. Mueller reported that four measures requiring learning within the test were as valid a predictor as the better tests when compared to the achievement test criterion. The PMAT and S-B were the best predictors with the author suggesting that either the ITPA or PTI could be interchanged with the S-B and maintain predictive ability. Seven general factors were found in the analysis and will be reported in the review of factor analytic studies.

Institutionalized Retardates

Silverstein (1963) in a recent survey of testing programs in institutions has indicated that the WISC is surpassed in usage only by the S-B. However, few studies investigating the validity of psychometric instruments in predicting the learning rate of the mentally retarded are reported in the literature. (Baumeister, 1964) The identification of retardates who may be quick to learn certain skills or be easily rehabilitated has been investigated in only a few studies. Little (1960) in a review of studies with the WISC states that predictive validity is restricted to correlations between the WISC and some nontest measure of predicted behavior obtained at some time subsequent to the administration of the WISC.

Salvati (1960) studied 62 institutionalized retardates ranging in age from 6-9 to 15-0 with IQ's between 45 and 88. It was found that the WISC P IQ significantly predicted manual learning rate and that the WISC V IQ predicted verbal learning rate. Criterion measures were a similarities learning test as a verbal measure and the CPM and Seguin Form Board as measures of manual learning.

WISC mental age equivalents were found to correlate better than WISC IQ's with the scores on the Metropolitan Achievement Test It was further reported that IQ's were better correlated with gain scores on the same test. No significant differences were reported between mental age equivalents and IQ's in the degree to which they were correlated with Salvati's experimental learning tasks. The low correlations obtained between most of the WISC scores and learning task scores were attributed to the restricted range of IQ's characteristic of the population studied. McNemar (1949) indicated the magnitude of the correlation coefficient diminishes as the traits correlated become homogeneous, or restricted in range.

Stroud, Blommers, and Lauber (1957) attempted to determine the effectiveness with which all or various combinations of the WISC subtests could be used to predict performance in reading, comprehension, arithmetic, and spelling by 725 slow learning children in grades three to six. The authors reported that arithmetic, vocabulary, block design, and object assembly subtests were most effective in predicting achievement on the Iowa Test of Basic Skills.

They further concluded that their study gave no support for the use of separate verbal or nonverbal scores in differential prediction.

Kimbrell (1960) compared PPVT and WISC scores obtained with institutionalized retardates and related the scores to academic achievement. Sixty-two subjects ranging in age from 10-5 to 15-8 ($\overline{X}$ = 13-8) were administered the Gray-Votaw-Rogers Achievement Test. Results yielded correlations of .43 and .41 between PPVT forms A and B and the WISC V IQ; between PPVT, A and B, and WISC FS IQ correlations of .30 and .30 were found. Nonsignificant correlations were found between PPVT and WISC P IQ's. Derived MA's for the WISC correlated .40 ($p < .01$) with grade placement; PPVT MA's correlated .11 and .04.

Little (1960) concluded that the WISC relates to scores on academic achievement tests for certain groups of children quite well. In general, the Verbal Scale seems to relate to test-measured academic achievement better than the Performance Scale, but the relationship between ability and achievement should be subjected to much further investigation.

Hammill and Irwin (1965) studied the performance of mentally retarded children on the PPVT and the S-B with attention given to three factors: educational level, diagnostic category, and chronological age. A sample of 131 educable and 111 trainable mentally retarded (TMR) were tested. A validity coefficient of .40 for EMR IQ's was reported and .52 for TMR IQ's. The author concluded that PPVT and S-B IQ's correlated sufficiently well to have a moderate degree of predictive ability. Correlations for four etiological groups ranged from .53 to .67. Age groupings yielded correlations of .62 for the 6 to 12-6 age level, .69 for the 12-7 to 15-6 level, and .61 for the 15-7 to 17-0 age level.

The development of the third revision of the S-B was regarded as an advance in technical quality over the 1937 edition. (Churchill and Smith, 1966) Silverstein (1963) indicated the S-B to be the most widely used of all psychometric instruments. However, it was noted by most reviewers that more evidence of predictive validity for Form L-M of the S-B is desirable. Balinsky (1960) stated that the overlap between the 1960 revision and the 1937 version would increase the probabilty of validity equal to or greater than the earlier edition.

Budoff and Purseglove (1963) divided 46 institutionalized mentally retarded adolescents into two groups below and above an MA of 8-0. The PPVT MA's of the lower group correlated significantly more highly with the S-B Form L-M MA's than did the scores of the higher MA group. All the lower group's correlations were significant while their PPVT scores were lower than their S-B scores on all forms. In discussing the latter finding, which was in contrast to the findings of Tobias and Gorelick (1961) with sheltered workshop retardates, Budoff and Purseglove suggested that institutionalized patients are minimally stimulated in the area of vocabulary, as compared to retardates in sheltered workshops.

A study by Throne, Kaspar, and Schulman (1965) was another attempt to study the relationship of intelligence measures to a academic achievement. Their sample included 35 educable boys ranging in ages from 11-0 to 14-11 whose IQ's ranged from 50 to 77. All subjects were residential students in a school for exceptional children. S-B, WISC, PPVT, and Goodenough Draw-A-Person Test (DAP) scores were correlated with each other and the PPVT scores were then correlated with Metropolitan Achievement Scores. PPVT IQ's and WISC V and FS IQ's (r = .53, r = .45) were significant and corroborated Kimbrell's findings. The correlation with the WISC P IQ was not significant. Correlations between the S-B and the PPVT IQ's and MA's were .46 and .40, while PPVT correlations with the DAP were not significant. Again corroborating Kimbrell's findings, the PPVT scores did not correlate significantly with the average achievement scores. The findings make the assumption untenable that intelligence tests correlated with each other necessarily predict equally well common achievement criteria.

Language Tests and Achievement of Retardates

The advent of the ITPA has generated much research in the area of language development. The ITPA is an individually administered test designed to identify psycholinguistic abilities and disabilities in children between the ages of two and one-half and nine. The dimensions of the psycholinguistic abilities are measured by six tests at the representational level requiring comprehension and giving meaning to symbols used in communication. The subtests are Auditory Decoding, Visual Encoding, and Motor Encoding. Subtests evaluating abilities at the automatic sequential level provide measures of automatic habits which produce syntactical and inflectional aspects of language and the ability to remember a sequential structure. These subtests are Auditory-Vocal Automatic, Auditory-Vocal Sequencing, and Visual-Motor Sequencing. Many of the studies in this area have been related to school achievement and specific language deficits with retarded populations.

Mueller and Weaver (1964) compared language abilities of EMR subjects to whom the S-B and ITPA were administered. A correlation of .76 was obtained. With their subjects an automatic sequential level deficit was observed. Bateman (1965) strongly suggests that the automatic sequential functions are highly related to school achievement while representational level functions are not. Bateman accounted for this type of performance by suggesting the possibility of: (1) a greater training or educational emphasis on meaningful rather than on automatic language usage; (2) greater "actual" retardation or developmental lag in the habitual or automatic manipulation of linguistic symbols; or (3) automatic sequential level tasks being less motivating to retarded children than to the standardization population.

In an investigation of some psychological correlates of severe reading disability, Kass (1962) used the ITPA supplemented by five tests at the automatic sequential level. The supplement tests were: (1) Visual Automatic, (2) Sound Blending (Monroe), (3) Mazes (WISC), (4) Memory for Designs (Graham-Kendall), and (5) Perceptual Speed (PMAT). Results indicated that children with reading disabilities were deficient in seven of eight subtests at the automatic sequential level of language usage and in only one of six representational subtests.

Ragland (1964) attempted to explore factors which contribute to the consistent lag of reading achievement below predictions from MA's in EMR's. Fifteen EMR children who were reading one or more years below WISC MA equivalents and 15 children who were reading no more than six months below were selected from a residential school. All subjects had CA's between 12 and 16, MA's between 6-6 and 10-0, and WISC IQ's between 48 and 79. The ITPA was administered to all subjects. Results demonstrated retarded readers to be significantly lower than nonretarded readers on Auditory-Vocal Automatic, the total automatic sequential level, and total language age. The author concluded that the psycholinguistic factors which relate to reading are those at the nonmeaningful, automatic sequential level. Ragland, as did Kass (1962), found that retarded readers do as well as expected in visual decoding which is defined as understanding the visual symbol. Ragland suggests a refocusing on the arbitrary, mechanical nonmeaningful aspects of word recognition.

Group Tests and Achievement of Retardates

The use of group intelligence tests with public school children has been prevalent for an extended period of time. The group test has also been used extensively as a preliminary screening instrument to identify mentally retarded children. The use of group tests presents greater utility and efficiency when time is considered. Also the extent of their use in educational settings require a substantiation of their validity with institutionalized populations.

Silverstein (1963) reports the PMAT as one of the few group tests useful with the mentally retarded. The PMAT is designed to measure both multi-factor and general intelligence.

Cassel and Danenhower (1949) used the 5-7 Form of the PMAT in a study of endogenous and exogenous retardates attempting to evaluate subtest performance. It was reported that endogenous subjects had little variation between subtests while exogenous subjects had relatively high scores for Verbal, relatively low scores for Motor, and significantly low scores in Space. They also reported higher coefficients of variation for exogenous subnormals than endogenous.

Clausen (1965) attempted to study the PMAT subscores in retardates and normals while also investigating the pattern, scatter, and correlation of test scores with the Porteus Mazes and the CPM. Subjects for the Clausen study were 273 institutionalized retardates with IQ's between 50 and 75. The normal subjects ranged in age from eight to ten and were from public schools. Results indicate a deficiency for retarded subjects in Verbal, Space, and Quantitative test factors. Clausen concluded that the subtests of the 5-7 PMAT when applied to retardates' Space, Verbal, and Quantitative factors were below Motor and Perception areas. The finding that the tasks in the Verbal and Space subtests are difficult for the mentally retarded corroborates the same deficiency reported by Cassel and Danenhower (1949). Significant correlations between the Space factor of the PMAT and both the Raven and Porteus measures were reported. The authors concluded that the PMAT 5-7

Form is more adquate than the 7-11 Form due to inconsistent findings related to the latter form.

Mueller (1965) used the second level of the PMAT as one of six predictor tests of achievement in a study previously reported in this review. The PMAT correlated .79 with the overall criterion and was considered by the author to be a valid predictor of learning ability among primary educable mentally retarded children. Mueller (1968) explained that the relatively high coefficient resulted from the use of a predictor and criterion requiring group test precedures.

The PMAT was used by Goldstein, Moss, and Jordan (1965) as part of a pretest selection battery to identify educable mentally retarded. The study was designed to investigate the efficacy of the special class. Correlations with achievement measures were not reported since this was not the purpose of the total study.

Factorial Analyses of Tests with Retardates

In an extended attempt to study the mentally retarded and to determine the complex nature of their learning, numerous authors have factor analyzed tests to identify specific factors with this population. In a study by Heese (1942), using six tests, the gain scores of 50 subjects were correlated. He found that learning seemed related to specific factors. A factor analysis of the data revealed three common factors that seemed related to learning: Speed of Movement, Memory, and Perception. Simrall (1947) selected two tests highly related to mental age to identify factors of memory, spatial relations, and perception. Gain scores were not significantly related to any of the factors correlated with mental age. However, gain scores were associated with the memory factor which was independent of mental age.

More recent studies indicate the factorial structure to be more complex for subnormals than normals. Baumeister and Bartlett (1962) reported a strong General factor, a Verbal factor, and a Performance factor. They also report a fourth factor, Number, which is generally weaker than the previous three but a reliable one. In another study Baumeister, Bartlett, and Hawkins (1963) confirmed the fourth factor with another group of retardates.

Gallagher and Lucito (1961) compared the factor patterns of gifted, average, and retarded subjects. Gifted subjects numbered 131; average, 565; and retarded, 374. Mental retardates were found to be relatively strong on a Perceptual Organization factor and relatively weak on a Verbal factor. The results were reported as further support that the retarded do better on tasks using concrete visual materials than on those requiring reorganization of elements and verbal association skills.

Mueller (1965) concluded "that verbal ability, number ability, and perceptual ability are the primary components of learning ability for young EMR children." Mueller found the Auditory-Vocal Association subtest from the ITPA, and the Number Facility and Perceptual Speed from the PMAT to be the best predictors of his criterion of learning. He also recommended the use of the Auditory-

Vocal Sequencing from the ITPA, and the Picture Vocabulary subtest from the PTI in a composite predictive battery. A factor analysis of the subtests in Mueller's six predictor tests and criterion data yielded seven factors. One factor was uninterpreted and the remaining six were identified as: General Academic Achievement, General Verbal Ability, General Perceptual Ability, Association, Attention, and Short Term Memory. The General Academic Achievement factor was reported with high loadings on the PMAT total score, Number Facility, and Perceptual Speed. These findings suggest that number facility and perceptual speed tend to be among the most important aspects of academic achievement of EMR children between the ages of 7 and 11. The General Verbal Ability factor was based on strong loadings of the S-B and ITPA. Other tests with high loadings on this factor included the associations, encoding, and automatic subtests from the ITPA, PPVT, and PMAT Verbal Meaning. Perceptual aspects of intelligence accounted for the third factor of General Perceptual ability. Visual perception was reflected in the loadings of the CPM, the Form Discrimination and Immediate Recall subtests from the PTI, the Spatial Relations subtest from the PMAT, and the WISC Coding test. Mueller suggests that vision may be the more important channel of perception with young EMR's. The Association factor involved some visual perception but maintained a heavier loading on the association of symbols than on perceptual ability. ITPA association tests, all of the PMAT and PTI subtests, and the NYAT Core subtest were loaded highly on this factor. The Attention factor was comprised of subtests requiring a high level of attention to auditory stimuli. A Short Term Memory factor was also reported by Mueller with loadings on the Paired Associate Task and Immediate Recall subtest from the PTI. A seventh factor was left uninterpreted. Mueller concluded that the use of multiple criteria in validation studies has strong implications for future research in test development. The use of learning tasks in a battery was also porposed by Mueller.

Horner (1967) used data from mentally retarded children in a comparison of factors derived from a factor analysis of the ITPA and Parsons Language Sample (PLS; Stradlin, 1963). Fifty mentally retarded children ranging in age from 10 to 15 and having an IQ range from 16 to 89 were administered the ITPA and PLS. A factor analysis of the 15 subtests of the two instruments indicated high loadings on five different factors. Both the ITPA and PLS had high loadings on factors of "Immediate Recall of Auditory Symbols," "General Linguistic Ability," and "Comprehension and/or Expression" accounting for 70 percent of the variance. ITPA subtests with high factor loadings on the General Linguistic Ability factor, accounting for 34 percent of the variance, were those related to the ability to produce a verbal response to environmental stimuli as well as comprehending what is heard and seen. Auditory-Vocal Automatic, Visual Decoding, Visual-Motor Association, and Auditory-Vocal Association were loaded highest on the General Linguistic Ability. The composition of Immediate Recall factor indicates a heavy loading on the Auditory-Vocal Sequencing subtest of the ITPA. The Auditory-Vocal Sequencing subtest measures the ability to reproduce verbally a series of numbers presented auditorily. The Comprehension and Expression factor, accounting for 18 percent of the variance extracted, utilized the ITPA subtests of Vocal Encoding and Motor Encoding. The subtests in the Comprehension factor require the Ss to comprehend prior to expression and response. The test was originally purported as one to evaluate expression; however, with mentally retarded this is not upheld.

Age Effects upon Achievement Prediction

Another area having relevance to achievement prediction is the effect of age upon the effectiveness of predictive measures with the EMR. Few related studies are found in the literature on the age effect. Reed (1958) in a study of the relationship between mental abilities and reading achievement at given developmental levels reported a change in both magnitude and composition of intelligence relating to specific tasks. Results of the study indicated that primary reading was independent of Thurstone's Verbal factor, whereas advanced reading is highly related to it. Reed states: "There is an individuation of the intellectual processes with increased age and complex reading tasks can best be predicted by specific components of intelligence rather than by gross measures."

In a review of IQ constancy, Clarke and Clarke (1958) concluded that "IQ constancy over long periods of time during the years of mental growth is the exception rather than the rule." The variation in test requirements and performance at succeeding age levels may alter the predictive effectiveness of psychometric instruments at each level.

The limitations of psychometric measures with specific age groups are related to intellectual development. Little (1960) has reported the lack of reliability and validity of the WISC with young mentally retarded children. Due to the limited number of items at the low level of the scale, caution was recommended in its use. With the advent of new tests for use with the young child, validities should be demonstrated prior to extensive use.

Clausen (1963) reports inconsistencies in PMAT test data and partially attributes the inconsistencies to domains of function which differentiate at various age levels, Domains such as sensory, motor, perceptual, and intelligence functions were evaluated by Clausen. He reported that while sensory and perceptual functions are highly differentiated in retardates, motor and intelligence are less highly differentiated. In the same study the PMAT Form 7-11 was reported as differentiating retardates less effectively than Form 5-7 for younger children.

In an analysis of functions of the 1960 S-B, Satter (1965) found different factors being measured by the test at various age levels. Age ranges of 2-5, 6-10, 11-14 and two broad ranges of 2-10 and 11+ were designated in the analysis. At the early (2-5) level the test measured visual-motor capacities, nonverbal reasoning, social intelligence, and language function. More advanced cognitive functions such as nonmeaningful memory and numerical reasoning, were measured during the 6-10 year range. In the 11-14 year range, verbal reasoning becomes prominent and the test moves to conceptual thinking and more advanced reasoning. Thus, qualitative analyses of test performance must consider age as a variable.

Summary

The number of school aged children placed in residential schools has increased steadily in the past decade. With the increase has been a concomitant change in the philosophy of the residential school from a terminal placement to a temporary placement, particularly with children who are educable. The emphasis on rehabilitation or habilitation to the community has focused attention on the need for the development of educational programs. Presently the number of children eligible for existing educational programs is too large to accomodate all. Therefore, the procedure for selection of children for special classes becomes crucial in order that those who may benefit most from an educational placement be identified.

A review of the literature reveals evidence of numerous attempts to investigate the relationship of psychometric measures to learning and achievement. The validation of tests by comparison to other "established tests" or achievement have yielded equivocal results.

Individual tests have been used with little attention given to the use of combinations of tests and subtests or to the identification of factors related to the learning of young institutionalized educable mentally handicapped children.

Recent factor analyses have indicated verbal ability, number ability, and perceptual ability to be the primary components of learning for the educable mentally retarded. Some researchers have demonstrated the utility of learning task performance to predict the achievement level of the retarded. Various tests, subtests, and tasks have demonstrated high relationships with measures of verbal, numerical, and perceptual abilities suggesting that the improved prediction of achievement can be realized through a combination of these related measures.

The studies cited indicate the need to regard age as an important factor in intellectual development and test performance. The researchers attempted to investigate the effect of various age ranges upon the young educable mentally retarded.

Results of studies pertaining to a valid procedure for the prediction of learning and achievement of young educable mentally retarded remain inconclusive. With the advent of new tests for use with young children, use of test combinations and factorial information could improve the prediction of learning and achievement with institutionalized youth.

Chapter III

PROCEDURES

The procedures followed in this study will be presented in this chapter. Aspects of the present study concerning sample, instruments, experimental procedure, and analyses of data will be presented in detail.

Sample

The subjects were 55 EMR's enrolled in educational programs at The Pennsylvania State University Demonstration School at the Cresson State School and Hospital, Cresson, Pennsylvania, and The Selinsgrove State School and Hospital, Selinsgrove, Pennsylvania. Four subjects were excluded from the sample, two for reasons of transfer from the institution, and two who were testable on some measures but untestable on other measures. The final sample of 51 subjects constituted the total available subjects meeting the following selection criteria at the institutions: (1) Between the chronological ages of 6-7 and 12-6 at the time of pretest data collection; (2) An IQ between 50 and 75 on an individually administered intelligence test given no more than one year prior to the pretest data collection; and (3) No physical or sensory handicap which would significantly interfere with independent mobility or manipulation of test materials.

The subjects were classified on the basis of chronological age into three groups ranging from (a) 6-7 to 8-6; (b) 8-7 to 10-6; and (c) 10-7 to 12-6. This subdivision was made to enable analyses of data related to age differences.

Instruments

Ten predictor tests and two achievement criterion tests were administered to each subject. The tests were selected to provide a basis for achievement prediction and achievement level of the sample. Measures were selected which have received wide usage with EMR's or have become available in recent years. The newer measures have demonstrated signs of utility either through format or parsimony in time required for administration and skill required of the examiner. More detailed information concerning all tests administered, their reliabilities, and validities is presented in Appendix A.

Tests designated as predictor tests included six individually administered intelligence tests, one group intelligence test, and three learning tasks. Since the S-B has received wide usage as an established intelligence test, it was included as a comparative measure in evaluating the validity of the other predictive instruments. The PTI, WPPSI, and ITPA were included due to their recent development, suitability for use with young children, and demonstrated promise in prior studies. For reasons of brief administration time and limited skills required for administration the QT and SIT were included as predictor measures. The PMAT was included because of it's established validity in a similar study (Mueller, 1965) and because it is a group measure often used in screening large groups of probable EMR's.

Three learning tasks were also designated as predictor tests on the basis of their brief administration time and prior research indicating the utility of learning samples as predictors of achievement. The tasks required the subject to demonstrate learning as part of the task. One task was the Coding A Test from the WISC which requires the subject to associate and reproduce printed symbols during a two minute period. The coding task was administered twice to minimize the effect of merely reproducing the symbols imitatively. A pilot study indicated two administrations of the coding to be more effective than three administrations due to an inability to maintain the interest and attention of the retarded child. The Paired Associate Task (PAT) requires the subject to learn numbers by their association with animal pictures. On the Order Learning Task (OLT) the subject demonstrates learning by selecting descriptions and directions for the learning tasks are presented in Appendix A.

Achievement tests which provided the criterion score were the WRAT and NYAT. These tests provide individual and group measures of reading and arithmetic achievement levels. Also, the WRAT provides a measure of spelling achievement and the NYAT a measure of core achievement. Both tests have been used extensively with retarded children. The WRAT has been the most readily available, standardized, individually administered achievement test and the NYAT the most readily available test for use specifically with mentally retarded children. In Appendix A more detailed information concerning a description of the tests and their reliabilities and validities is presented.

Procedures

The ten predictor tests and achievement criterion measures were administered to all subjects to complete the pretest data collection. The six individually administered intelligence tests and three learning tasks were administered in a random order by three examiners following the procedures set forth in the various test manuals. The examiners were prepared through graduate study and supervised professional experience in the administration of individually administered tests. They were briefed about the purpose and design of the study and familiarized with specific problems in data collection prior to testing. Tests for each subject were administered by the same examiner. Subjects were tested in time blocks of no longer than one hour on any one day to minimize the possibility of subject fatigue. A period of time ranging from one to three weeks was required to complete the testing of all subjects with the predictor tests. The PMAT was administered to groups of five to ten subjects by an examiner and a proctor (i.e., two examiners). The group administrations were accomplished in two sessions on two consecutive days. Criterion measures were administered within a four day period by the same examiners. The WRAT was administered individually by the examiner who had administered the predictor tests. The NYAT was administered to small groups of five to ten subjects in three sessions by an examiner and a proctor. Each of the three subtests were administered in a separate administration period not exceeding one hour. Only one subtest was given each day. All tests were scored by the examiner and rescored and recorded by the investigator.

Following a seven month period, during which all subjects attended school in their respective institutions, the criterion tests and the three learning tasks were readministered to complete the posttest data collection. Subtests of the WRAT and the NYAT were administered in the same order during pretest and posttest data collection to maintain a uniform period of time between testing.

Analyses

Data collection yielded raw and derived scores for the predictor and criterion measures. Scores on the six individually administered predictor tests were derived from the norms published in their respective manuals. Mental ages, age equivalents, or standard scores were utilized in the analyses relating to the hypotheses. A separate exploratory analysis utilizing IQ's was made due to the effect of the CA in deriving IQ's. IQ's were not available for all predictor tests. Since total mental age scores were not available for the PMAT, a mean mental age for the four subtests was derived. Mean verbal, performance, and full scale age equivalent scores were computed to analyze WPPSI test data. Raw scores on the predictor learning tasks and criterion measures were converted to standard _T_ scores to facilitate the combination of subtests. The number of correct responses indicated the raw scores to be transformed to standard scores. When appropriate for the analyses subtest scores were combined to obtain total scores.

Raw gain scores were calculated for pre and post achievement subtests for each subject. The gain scores were then transformed to standard scores to facilitate pooling of scores for the analyses. The Overall Achievement Criterion Score (OACS) was obtained by computing the mean standard gain score for the six subtests in the WRAT and NYAT. Arithmetic subtest gain scores, converted to standard scores, from the achievement batteries were averaged to designate the Arithmetic Achievement Criterion Score (AACS). Reading achievement gain scores were processed in the same manner to obtain a mean reading gain score to provide the Reading Achievement Criterion Score (RACS).

Subtest scores used as predictor measures were obtained by combining the subtest age scores into a total standard score. This procedure was the same for the subtests combined as predictor measures in Hypotheses I, II, and III. Composite Predictor Score One (CPS1) is comprised of the total age scores of the subtests set forth in Hypothesis I. A combination of subtest age scores designated in Hypothesis II provide the Composite Predictor Score Two (CPS2). Composite Predictor Score Three (CPS3) was obtained by combining the age scores of subtests presented in Hypothesis III. The Composite Learning Task Score (CLTS) to be analyzed as a predictor measure was obtained by averaging the standard scores of the three learning tasks.

The techniques of correlation and multiple regression were employed in analyses of the data. To determine the differences in validity coefficients for selected measures the t tests for differences between correlations computed with the same population were used. (Walker and Lev, 1956) Further analysis included the computing of t values for differences between means of correlated samples equal in size. Multiple regression analyses with parsimony were performed to obtain optimum and parsimonious predictors as set forth in the hypotheses. Selected subtests were subjected to a multiple regression analysis to indicate the optimum combination of subtests to predict the achievement criterion. These selected subtests plus the achievement measures were then subjected to a principal-axis factor analysis and a varimax orthogonal rotation of the resulting factors. Standard library computer programs for the IBM 360 computer were used.

Summary

The sample, method of obtaining the sample, description of instruments, and procedure for data collection were presented in this chapter. The derivation of scores utilized and the statistica analyses made were also described. The results of the analyses and a discussion of the results will be presented in Chapter IV.

Table 1 Means and Standard Deviations for Variables Included in the Statistical Analyses

Variable	$\overline{X}^a$	SD^b
Chronological Age	124.71	20.48
Stanford-Binet, MA	70.12	12.17
Stanford-Binet, IQ	58.14	7.66
Illinois Test of Psycholinguistic Abilities, LA	63.98	15.60
ITPA Auditory-Vocal Automatic, LA	58.00	20.71
ITPA Visual Decoding, LA	70.35	21.98
ITPA Motor Encoding, LA	71.24	19.94
ITPA Auditory-Vocal Association, LA	63.92	18.21
ITPA Visual-Motor Sequencing, LA	65.86	15.92
ITPA Vocal Encoding, LA	73.00	21.86
ITPA Auditory-Vocal Sequencing, LA	54.00	19.62
ITPA Visual-Motor Association	69.63	18.56
ITPA Auditory Decoding, LA	62.65	21.32
Pictorial Test of Intelligence, MA	68.60	14.79
Pictorial Test of Intelligence, IQ	55.96	12.03
PTI Picture Vocabulary, MA	75.70	19.14
PTI Form Discrimination,MA	64.27	20.83
PTI Information & Comprehension, MA	64.78	17.57
PTI Similarities, MA	65.31	17.77
PTI Size & Number, MA	71.58	17.58
PTI Immediate Recall, MA	68.47	27.78
Wechsler Preschool & Primary Scale of Intellegence Mean Verbal Subtest, AE	63.41	10.75
WPPSI Mean Performance Subtest, AE	66.98	12.75
WPPSI Mean Full Scale, AE	65.17	11.20
WPPSI Information, AE	63.82	12.23
WPPSI Vocabulary, AE	60.29	13.71
WPPSI Arithmetic, AE	66.45	13.10
WPPSI Similarities, AE	66.80	12.84
WPPSI Comprehension, AE	59.78	14.99
WPPSI Animal-House, AE	68.19	15.10
WPPSI Picture Completion, AE	66.74	14.93
WPPSI Mazes, AE	64.00	17.53
WPPSI Geometric Designs, AE	67.76	12.32
WPPSI Block Design, AE	67.05	13.34
Quick Test 1-2-3, MA	67.78	18.50
Quick Test 1-2-3, IQ	58.54	9.22
Slosson Intelligence Test, MA	71.51	12.84
Slosson Intelligence Test, IQ	58.54	9.22
Primary Mental Abilities Test, Mean Subtest MA	76.51	9.58
PMAT Verbal Meaning, MA	73.60	10.71
PMAT Spatial Relations, MA	83.56	15.64
PMAT Number Facility, MA	75.56	9.11

Table 1 (Continued)

Variable	$\bar{X}^a$	SD^b
PMAT Perceptual Speed, MA	74.66	13.23
Composite Predictor Score One, Combined MA	345.07	62.69
Composite Predictor Score Two, Combined MA	279.49	48.85
Composite Predictor Score Three, Combined MA	269.37	53.64
Coding, Pretest RS	55.16	28.22
Paired Associate Task, Pretest RS	22.96	13.03
Order Learning Task, Pretest RS	31.49	10.20
Coding, Posttest RS	71.29	36.77
Paired Associate Task, Posttest RS	28.78	12.18
Order Learning Task, Posttest RS	31.92	8.20
Composite Learning Task Score, Combined RS	105.88	13.48
Overall Achievement Criterion Score Total Mean Gain Score, RS	27.43	5.10
Arithmetic Achievement Criterion Score, Total Mean Arithmetic Gain Score, RS	4.49	.63
Reading Achievement Criterion Score, Total Mean Reading Gain Score, RS	4.96	.41

[a] Mean age scores reported in months

[b] Standard deviations of age scores reported in months

and 7 on core, totaling a mean gain of 17. A total mean gain score of 27 for both the WRAT and the NYAT was achieved by the subjects.

Correlation Analyses

Correlation analyses were performed to obtain information which would indicate the validity of the measures in predicting criterion scores. The correlation coefficients of predictor measure age equivalent scores and the Overall Achievement Criterion Score (OACS) are presented in Table 2. Coefficients shown in the table range from .30 for the PMAT, mean mental age, to multiple correlation coefficient (R) of .52 for the combined subtests. Tests of significance to determine the difference between correlations were carried out using a standard library computer program. With the OACS the R resulting from the CPS1 was significantly higher than the QT and PMAT mental ages. No significant differences between the remaining predictor tests were indicated. The CPS1 demonstrated a higher validity coefficient than any of the individual predictor tests when correlated with the OACS.

Utilizing Arithmetic Achievement Criterion Scores (AACS) correlations ranged from .27 for the QT to .54 for the SIT. Using the arithmetic achievement as criterion the SIT correlation coefficient was significantly higher than coefficients yielded by the QT and PMAT. Most of the correlations were divided between those of a moderate and low level.

Correlations with the Reading Achievement Criterion Score

Table 2 Correlations of Predictor Test Age Equivalents with Criterion Scores (N = 51)

Test	Criterion Scores		
	OACS	AACS	RACS
S-B, MA	.355	.385	.463
ITPA, LA	.392	.494	.364
PTI, MA	.349	.391	.275
WPPSI, Mean Verbal AE	.420	.487	.264
WPPSI, Mean Performance AE	.402	.459	.414
WPPSI, Mean Full Scale AE	.436	.497	.315
QT, MA	.313	.266	.386
SIT, MA	.447	.539	.243
PMAT, Mean Subtest MA	.295	.328	.459
CPS1	.523	----	----
CLTS	.428	----	----
CPS2	----	.518	----
CPS3	----	----	.423

r = .361 Significant .01 level

(RACS) in Table 2 indicate low to moderate correlations ranging from a low of .24 by the SIT mental age to a high of .46 by the S-B MA. The S-B mental age and PMAT mean subtest age demonstrated moderate correlation coefficients higher than coefficients for the PTI, WPPSI V, and SIT. A greater number of low correlations were found with the RACS than with either the OACS or the AACS. All predictor tests correlated positively with the criterion scores, and most of the correlations were found to be significantly different from zero.

In Table 3 correlation coefficients indicating the relationship between IQ and achievement are presented. IQ's were available from four of the measures. When compared to the correlation coefficients determined from age equivalents in Table 2 it is evident that the IQ's for the SIT and S-B equal or exceed the predictive validity for the CPS1 with the OACS. When the RACS is used as the criterion measure, the SIT and S-B again demonstrate equal or higher predictive validity than the R of the combined subtests. For the subjects in this study the level of brightness, as reflected in IQ, seems to be more important in predicting learning than mental age or its equivalent.

Table 3 Correlations of Predictor Test IQ's with Criterion Scores (N = 51)

Criterion	IQ Scores			
	S-B	PTI	QT	SIT
OACS	.568	.508	.306	.618
AACS	.442	.414	.306	.508
RACS	.505	.267	.245	.471

r = .361 Significant .01 level

Multiple Regression Analyses

Following the correlational analyses a number of multiple regression analyses were employed to determine the validity of selected subtests as predictors of the criterion measures. By completing the analyses the multiple correlations resulting from the subtests set forth in the respective hypotheses could be compared to correlations resulting from single individual and group predictor tests. In all tables in which multiple regression analyses are reported the percent of variance explained and a corrected R are reported. The corrected R includes a correction for shrinkage since the correlation between observed and predicted values for a new sample tends to be less than the R obtained from the original sample. The formula used to compute the corrected R is that presented by McNemar (1949). The standard error of estimate (SE) for multiple correlations reported were computed by the procedure set forth by McNemar (1949).

Results from the multiple regression analysis of subtests designated in Hypothesis I pertaining to overall achievement

Chapter IV

RESULTS AND DISCUSSION

In this chapter the results of analyses of the test data are presented. The results are based upon the scores of the 51 subjects who received the complete battery of tests.

Results

Descriptive Data

In Table 1 the means and standard deviations for scores on each of the variables included in the analysis are reported. Predictor measures ranged in age equivalents from a low of 63 and 64 months on the WPPSI Verbal and ITPA, respectively, to a high of 76 months on the PMAT. The PMAT mean age equivalent was significantly higher than the mean age equivalents of all other predictor tests. The S-B, PTI, and SIT mean mental ages were significantly higher than the mean age scores of the WPPSI V and FS and the ITPA. Subtest scores on the ITPA, PTI, WPPSI, and PMAT ranged from 54 months (Auditory-Vocal Sequencing, ITPA) to 83 months (Spatial Relations, PMAT). Results on intelligence tests ranged from an IQ of 55 on the QT to an IQ of 72 on the SIT. On the WRAT subtests subjects earned mean and raw gain scores of 5 for reading, 2 for spelling, 3 for arithmetic, and 10 for total score. On the NYAT subtests the subjects attained mean gain scores of 5 on reading, 5 on arithmetic, indicated that only one subtest predicted the OACS as efficiently as the combination of subtests. The analysis yielded a regression coefficient of .215 and a Beta weight of .508 for the Picture Vocabulary subtest of the PTI, resulting in a multiple correlation of .507. The R reported in Table 4 for the Picture Vocabulary subtest of the PTI was not significantly enhanced by the utilization of all five subtests specified in Hypothesis I. A multiple correlation of .524 was yielded when all predictor subtests were utilized. The R of .507 accounts for 26 percent of the explained variance leaving a significant 74 percent of the variance not explained by the resulting subtest. A multiple correlation of .524 accounts for 27 percent of the variance. Correlations below .34 were significantly lower than the R reported for the CPS1 when the rationale warranted comparisons. Multiple tests of significance between all predictor tests and the R were not performed due to a lack of rationale for such comparisons and the probability of differences due to chance being misinterpreted.

A second multiple regression analysis was made utilizing the four subtests presented in Hypothesis II pertaining to arithmetic achievement. With all four subtests the correlation coefficient was a moderate .518, explaining 27 percent of the variance. Reduction of variables resulted in an R, which indicated that the Auditory-Vocal Association ITPA) and the Arithmetic (WPPSI) subtests predict the AACS as efficiently as do four proposed subtests. A regression coefficient of .116 and a Beta weight of .251 for the

Table 4 Results of Multiple Regression Analysis of Subtests Designated to Predict OACS (N = 51)

Subtests	Coef.	Beta[a]	R	SE	Con[b]	% Exp. Var.	R[c]
PTI Pic. Vocab.	.215	.508	.507	.10	37.88	26	.45
PTI Pic. Vocab.	.216	.510	.522	.10	36.20	27	.45
ITPA Aud.-Voc. Assoc.	.265	.123					
PTI Pic. Vocab.	.209	.494	.523	.10	34.49	27	.45
ITPA Aud.-Voc. Assoc.	.269	.125					
PMAT Perc. Speed	.142	.036					
PTI Pic. Vocab.	.211	.497	.524	.10	36.04	27	.45
ITPA Aud.-Voc. Assoc.	.273	.127					
PMAT Perc. Speed	.214	.055					
PMAT Num. Fac.	-.157	-.028					
PTI Pic. Vocab.	.211	.497	.542	.10	36.05	27	.45
ITPA Aud.-Voc. Assoc.	.273	.127					
PMAT Perc. Speed	.214	.055					
PMAT Num. Fac.	-.157	-.028					
ITPA Aud.-Voc. Auto.	-.292	-.001					

[a] Coefficient for prediction formula using standard scores

[b] Constant for prediction formula

[c] Multiple correlation coefficient corrected for shrinkage

Auditory-Vocal Association subtest and a coefficient of .189 and a Beta weight of .294 for the Arithmetic subtest resulted in an R of .482. The two subtests reported account for 24 percent of the variance of the criterion with 76 percent of the variance not explained. The inclusion of two eliminated subtests did not improve the R significantly or explain a considerably increased percentage of the variance. The results of the multiple regression analyses for the four subtests are found in Table 5. Correlations below .32 were significantly lower than the R yielded by the CPS2.

Specified subtests in Hypothesis III pertaining to reading achievement resulted in an R of .423 and accounted for 17 percent of the explained variance of the criterion measure. The Auditory-Vocal Association (ITPA) subtest with a coefficient of .138 and a Beta weight of .400 accounted for sixteen percent of the explained variance (See Table 6). The inclusion of all four subtests contributed to explaining an additional two percent of the variance; however, the value of administering four subtests for the minimal gain would not be practical.

A fourth multiple regression analysis was performed to evaluate the use of the learning tasks as predictors of the OACS. Results demonstrate an R of .428 as the degree of prediction achieved by the weighted learning tasks. As shown in Table 7 further analysis of the scores resulted in the identification of the Order Learning Task as the major contributor among the task predictors of OACS. A regression coefficient of .214 with a Beta weight of .395 indicated an R of .395 explaining 16 percent of the variance.

Table 5 Results of Multiple Regression Analysis of Subtests Designated to Predict AACS (N = 51)

Subtests	Coef.	Beta[a]	R	SE	Con[b]	% Exp. Var.	R[c]
ITPA Aud.-Voc. Assoc.	.281	.438	.43	.11	30.95	19	.40
ITPA Aud.-Voc. Assoc.	.116	.251	.482	.11	29.70	24	.42
WPPSI Arith.	.189	.294					
ITPA Aud.-Voc. Assoc.	.170	.368	.513	.10	39.79	26	.47
WPPSI Arith.	.236	.367					
PMAT Num. Fac.	-.220	-.238					
ITPA Aud.-Voc. Assoc.	.161	.349	.518	.10	41.23	27	.48
WPPSI Arith.	.210	.327					
PMAT Num. Fac.	-.262	-.283					
PTI Size & Number	.556	.116					

[a] Coefficient for prediction formula using standard scores

[b] Constant for prediction formula

[c] Multiple correlation Coefficient corrected for shrinkage

Table 6 Results of Multiple Regression Analysis of Subtests Designated to Predict RACS (N = 51)

Subtests	Coef.	Beta[a]	R	SE	Con[b]	% Exp. Var.	R[c]
ITPA Aud.-Voc. Assoc.	.137	.400	.416	.10	41.60	16	.36
ITPA Aud.-Voc. Assoc.	.996	.289	.419	.10	35.38	17	.36
PMAT Num. Fac.	.114	.166					
ITPA Aud.-Voc. Assoc.	.108	.315	.423	.11	35.24	18	.36
PMAT Num. Fac.	.135	.196					
ITPA Vis.-Mot. Seq.	-.306	-.077					
ITPA Aud.-Voc. Assoc.	.108	.315	.423	.11	34.93	18	.36
PMAT Num. Fac.	.143	.207					
ITPA Vis.-Mot. Seq.	-.279	-.071					
PTI Form Dis.	-.676	-.022					

[a] Coefficient for prediction formula using standard scores

[b] Constant for prediction formula

[c] Multiple correlation coefficient corrected for shrinkage

Table 7 Results of Multiple Regression Analysis of Learning Tasks Designated to Predict OACS (N = 51)

Learning Task	Coef.	Beta[a]	R	SE	Con.[b]	% Exp. Var.	R[c]
Order Learning	.213	.394	.395	.12	39.25	16	.36
Order Learning	.650	.126	.412	.10	37.16	17	.37
Coding	.190	.351					
Order Learning	.202	.374	.428	.11	38.38	18	.39
Coding	.102	.198					
Paired Associate	-.737	-.141					

[a] Coefficient for prediction formula using standard scores

[b] Constant for prediction formula

[c] Multiple correlation coefficient corrected for shrinkage

Seventy-four percent of the variance remained unexplained with only an additional two percent explained by the inclusion of the Coding and PAT as predictors.

Test-retest reliability coefficients for the learning tasks taken over a seven month period were Coding, .56; PAT, .44; and OLT, .40. Correlations of the learning tasks with the criterion are presented in Table 8.

Following the analyses related specifically to the first four hypotheses, all variables designated in Table 9 were submitted to a multiple regression analysis to obtain the subtests for optimal prediction of the OACS. Thirty-five predictor variables were included in the analysis. Total scores or those dependent upon two or more of the 35 variables were excluded from the analysis.

Results of the multiple regression analysis indicated the expected gradual decrease in the R as variables were eliminated from the analysis. Results of the analysis indicate that minimal improvement in the R was realized beyond the use of three variables: Immediate Recall from the PTI, and the Auditory-Vocal Automatic and Auditory-Vocal Sequencing from the ITPA. The practical utility in time of test administration and the limited enhancement of the R suggests the three variable regression equation to be the most efficacious predictor. The results of the final six variables and eliminations are presented in Table 10.

Table 8 Correlations of Learning Tasks with Criterion Scores (N = 51)

	Criterion Scores		
Learning Task	OACS	AACS	RACS
Coding	.247	.250	.288
PAT	.097	.181	.033
OLT	.395	.260	.409
CLTS	.428	----	----

r = .361 Significant .01 level

The phase of the study concerned with achievement prediction at different age levels was approached through analyses with the subjects divided into three age groups.

Separate multiple regression analyses were completed, to determine the validity of the subtests proposed in Hypothesis I,

Table 9 Variables included in Multiple Regression of Selected Tests and Subtests

Variable
Stanford-Binet, MA
ITPA Auditory-Vocal Automatic, LA
ITPA Visual Decoding, LA
ITPA Motor Encoding, LA
ITPA Auditory-Vocal Association, LA
ITPA Visual-Motor Sequencing, LA
ITPA Vocal Encoding, LA
ITPA Auditory-Vocal Sequencing, LA
ITPA Visual-Motor Association, LA
ITPA Auditory Decoding, LA
PTI Picture Vocabulary, MA
PTI Form Discrimination, MA
PTI Information and Comprehension, MA
PTI Similarities, MA
PTI Size and Number, MA
PTI Immediate Recall, MA
WPPSI Information, AE
WPPSI Vocabulary, AE
WPPSI Arithmetic, AE
WPPSI Similarities, AE
WPPSI Comprehension, AE
WPPSI Animal-House, AE
WPPSI Picture Completion, AE
WPPSI Mazes, AE
WPPSI Geometric Designs, AE
WPPSI Block Design, AE
Quick Test 1-2-3, MA
Slosson Intelligence Test, MA
PMAT Verbal Meaning, MA
PMAT Spatial Relations, MA
PMAT Number Facility, MA
PMAT Perceptual Speed, MA
Coding, RS
Paired Associate Task, RS
Order Learning Task, RS

Table 10 Results of Multiple Regression Analysis of Selected Tests and Subtests to Predict OACS (N = 51)

Variable	Coef.	Beta[a]	R	SE	Con.[b]	% Exp. Var.	R[c]
PTI Im. Rec.	.302	.569	.570	.10	30.25	33	.52
PTI Im. Rec.	.242	.192	.591	.09	26.29	34	.53
ITPA Aud.-Voc. Auto.	.116	.457					
PTI Im. Rec.	.240	.453	.650	.08	27.26	42	.63
ITPA Aud.-Voc. Auto	.334	.552					
ITPA Aud.-Voc. Seq.	-.196	-.448					
PTI Im. Rec.	.283	.534	.686	.07	33.47	47	.63
ITPA Aud.-Voc. Auto.	.551	.158					
ITPA Aud.-Voc. Seq.	-.215	-.491					
WPPSI Arith.	-.337	-.437					
PTI Im. Rec.	.238	.449	.710	.07	27.24	50	.66
ITPA Aud.-Voc. Auto.	.448	.741					
ITPA Aud.-Voc. Seq.	-.185	-.424					
WPPSI Arith.	-.343	-.445					
Coding	.187	.263					
PTI Im. Rec.	.262	.494	.743	.06	41.30	55	.68
ITPA Aud.-Voc. Auto.	.544	.900					
ITPA Aud.-Voc Seq.	-.193	-.442					
WPPAI Arith.	-.353	-.457					
Coding	.282	.396					
PMAT Perc. Speed	-.367	-.354					

[a] Coefficient for prediction formula using standard scores

[b] Constant for prediction formula

[c] Multiple correlation coefficient corrected for shrinkage

with each of the three age groups designated in Corollary I. The optimal combination of the Auditory-Vocal Automatic (ITPA) subtest and the Picture Vocabulary (PTI) subtest resulted in an R of .747 when used with Age Group One. Weightings and coefficients are presented in Tables 11, 12 and 13 for the three age groups. With Age Group Two an R of .673 is yielded by the weighting of the Auditory-Vocal Association (ITPA) and the Picture Vocabulary (PTI). For Age Group Three an R of .549 was obtained by the regression equation including the Number Facility and Perceptual Speed subtests from the PMAT. An R of .588 was found with five predictors.

The criterion measure in each of the multiple regression analyses was the OACS. The R for Age Group One was significantly higher than the R yielded for Age Group Three. There was no significant difference between the R's of Age Group One and Two.

Factor Analysis

Forty-one variables were selected from the overall correlation matrix for factor analysis. Variables were selected to eliminate duplication of variables or minimize effects of interdependency. The variables which were included in the factor analyses are listed in Table 14. Variables are identified in subsequent tables by the numerical assignment listed in Table 14.

A principal-axis factor analysis was performed using a standard program for the IBM 360 computer. Four factors resulted from the analysis and are reported in Table 15. A strong general ability

Table 11 Results of Multiple Regression Analysis for Age Group One of Subtests Designated to Predict OACS (N = 8)

Subtests	Coef.	Beta[a]	R	SE	Con.[b]	% Exp. Var.	R[c]
PTI Pic. Vocab.	.324	.645	.645	.08	29.98	42	.61
PTI Pic. Vocab.	.277	.553	.747	.06	20.29	56	.72
ITPA Aud.-Voc. Auto.	.227	.387					
PTI Pic. Vocab.	.199	.397	.779	.05	14.78	61	.75
ITPA Aud.-Voc. Auto.	.270	.461					
PMAT Num. Fac.	-.174	-.268					
PTI Pic. Vocab.	.245	.489	.779	.05	12.31	61	.75
ITPA Aud.-Voc. Auto.	.301	.513					
PMAT Num. Fac.	-.143	-.221					
ITPA Aud.-Voc. Assoc.	-.325	-.112					
PTI Pic. Vocab.	.253	.505	.779	.05	14.05	61	.75
ITPA Aud.-Voc. Auto.	.336	.574					
PMAT Num. Fac.	-.164	-.253					
ITPA Aud.-Voc. Assoc.	-.432	-.149					
PMAT Perc. Speed	-.631	-.058					

[a] Coefficient for prediction formula using standard scores

[b] Constant for prediction formula

[c] Multiple correlation coefficient corrected for shrinkage

Table 12 Results of Multiple Regression Analysis for Age Group Two of Subtests Designated to Predict OACS (N = 16)

Subtests	Coef.[a]	Beta	R	SE	Con.[b]	% Exp. Var.	R[c]
ITPA Aud.-Voc. Assoc.	.882	.362	.363	.12	45.58	13	.25
ITPA Aud.-Voc. Assoc.	.164	.674	.673	.07	22.23	45	.63
PTI Pic. Vocab.	.353	.647					
ITPA Aud.-Voc. Assoc.	.157	.645	.731	.06	30.92	53	.70
PTI Pic. Vocab.	.465	.852					
PMAT Perc. Speed	-.202	-.358					
ITPA Aud.-Voc. Assoc.	.150	.618	.740	.06	31.63	55	.71
PTI Pic. Vocab.	.332	.609					
PMAT Perc. Speed	-.251	-.445					
ITPA Aud.-Voc. Auto.	.175	.312					
ITPA Aud.-Voc. Assoc.	.150	.618	.740	.06	31.46	55	.71
PTI Pic. Vocab.	.332	.609					
PMAT Perc. Speed	-.252	-.445					
ITPA Aud.-Voc. Auto.	.174	.312					
PMAT Num. Fac.	.294	.001					

[a] Coefficient for prediction formula using standard scores

[b] Constant for prediction formula

[c] Multiple correlation coefficient corrected for shrinkage

Table 13 Results of Multiple Regression Analysis for Age Group Three of Subtests Designated to Predict OACS (N = 27)

Subtests	Coef.[a]	Beta	R	SE	Con.[b]	% Exp. Var.	R[c]
PMAT Perc. Speed	.144	.514	.377	.12	37.74	26	.23
PMAT Perc. Speed	.864	.308	.549	.09	33.64	30	.49
PMAT Num. Fac.	.108	.281					
PMAT Perc. Speed	.823	.294	.577	.09	35.68	33	.52
PMAT Num. Fac.	.113	.293					
ITPA Aud.-Voc. Assoc.	-.319	-.178					
PMAT Perc. Speed	.862	.308	.586	.09	35.41	34	.53
PMAT Num. Fac.	.988	.255					
ITPA Aud.-Voc. Assoc.	-.362	-.201					
ITPA Aud.-Voc. Auto.	.219	.106					
PMAT Perc. Speed	.815	.291	.588	109	35.71	35	.54
PMAT Num. Fac.	.735	.190					
ITPA Aud.-Voc Assoc.	-.343	-.191					
ITPA Aud.-Voc. Auto.	.183	.088					
PTI Pic. Vocab.	.409	.098					

[a] Coefficient for prediction formula using standard scores

[b] Constant for prediction formula

[c] Multiple correlation coefficient corrected for shrinkage

Table 14 Variables Included in Factor Analysis

Number	Variable
1	Stanford-Binet, MA
2	ITPA Auditory-Vocal Automatic, LA
3	ITPA Visual Decoding, LA
4	ITPA Motor Encoding, LA
5	ITPA Auditory-Vocal Association, LA
6	ITPA Visual-Motor Sequencing, LA
7	ITPA Vocal Encoding, LA
8	ITPA Auditory-Vocal Sequencing, LA
9	ITPA Visual-Motor Association, LA
10	ITPA Auditory Decoding, LA
11	PTI Picture Vocabulary, MA
12	PTI Form Discrimination, MA
13	PTI Information and Comprehension, MA
14	PTI Similarities, MA
15	PTI Size and Number, MA
16	PTI Immediate Recall, MA
17	WPPSI Information, AE
18	WPPSI Vocabulary, AE
19	WPPSI Arithmetic, AE
20	WPPSI Similarities, AE
21	WPPSI Comprehension, AE
22	WPPSI Animal House, AE
23	WPPSI Picture Completion, AE
24	WPPSI Mazes
25	WPPSI Geometric Designs
26	WPPSI Block Design
27	Quick Test, MA
28	Slosson Intelligence Test, MA
29	PMAT Verbal Meaning, MA
30	PMAT Spatial Relations, MA
31	PMAT Number Facility, MA
32	PMAT Perceptual Speed, MA
33	Coding, SS
34	Paired Associate Task, SS
35	Order Learning Task, SS
36	WRAT Reading Subtest, SS
37	WRAT Spelling Subtest, SS
38	WRAT Arithmetic Subtest, SS
39	NYAT Reading Subtest, SS
40	NYAT Arithmetic Subtest, SS
41	NYAT Core Subtest, SS

Table 15 Results of Principal-Axis Factor Analysis (N = 51)

Variable	Factors			
	I	II	III	IV
1	.926	.012	.132	.008
2	.741	-.049	-.002	.187
3	.451	.240	.117	-.082
4	.550	.134	.476	-.201
5	.832	-.025	-.239	-.031
6	.780	-.001	.246	-.054
7	.688	.027	-.080	.049
8	.787	-.028	-.152	-.299
9	.638	.170	-.209	-.153
10	.683	-.038	-.256	.192
11	.678	.104	.006	-.046
12	.727	-.164	.235	-.283
13	.779	.074	.374	.001
14	.706	-.026	-.117	-.214
15	.778	-.003	-.046	-.233
16	.668	.032	-.175	-.291
17	.851	.025	.041	.044
18	.804	-.076	-.033	.050
19	.778	.079	-.044	-.138
20	.613	.090	.104	-.157
21	.699	-.136	-.205	.079
22	.717	.072	.243	.488
23	.775	-.024	.426	.070
24	.796	-.083	-.011	.322
25	.810	-.064	.265	-.047
26	.799	-.082	.379	-.089
27	.670	.252	.256	-.186
28	.879	-.025	-.261	-.015
29	.681	.430	-.090	.130
30	.777	-.342	.142	.069
31	.730	-.499	-.145	.042
32	.757	-.343	-.126	-.188
33	.622	-.400	.099	.405
34	.380	.847	-.041	-.015
35	.527	-.226	-.120	-.350
36	.488	.762	-.152	.084
37	.743	.195	-.076	.288
38	.823	-.225	-.074	.014
39	.805	-.105	-.278	.113
40	.879	.154	-.181	.042
41	.791	.073	.051	.216

factor, identified as General Mental Ability, accounted for 55 percent of the explained variance while the Symbol Recognition, Short Term Memory, and Visual Association factors accounted for six percent, four percent, and four percent of the variance, respectively.

A varimax orthogonal rotation of the factor matrix was carried out to enable a more complete interpretation of the factors. The preservation of the general factor with a concomitant reduction of the number of negative factor leadings was the objective of the varimax rotation. The results of the rotation are presented in Table 16.

Summary of Results

In Hypothesis I it was indicated that a regression equation utilizing the specified subtests would result in a higher predictive validity coefficient for overall achievement than any single individual or group test and that the validity of the equation would be higher for Age Group One than for Age Groups Two and Three. The data from this study indicated that the Overall Achievement Criterion Score was more highly correlated with the multiple correlation resulting from the combined subtests than with any of the individually or group administered tests. The multiple correlation coefficient was higher for the younger age group than either of the two older age groups. The difference observed between the youngest and oldest age group was significant at the .01 level.

Table 16 Results of Varimax Factor Rotation (N = 51)

	Factors			
Variable	I	II	III	IV
1	.289	.254	.337	.294
2	.212	.161	.096	.453
3	.043	.125	.106	.037
4	-.024	.071	.163	.089
5	.183	.164	.207	.178
6	.148	.145	.717	.124
7	.021	.104	.313	.035
8	.404	.210	.463	-.030
9	.110	.327	.260	.070
10	.140	.073	.089	.285
11	.143	.220	.269	.195
12	.491	.020	.550	.150
13	.078	.177	.428	.296
14	.244	.204	.222	.153
15	.352	.272	.467	.139
16	.482	.196	.476	-.063
17	.092	.186	.352	.270
18	.070	.172	.287	.308
19	.107	.305	.736	.005
20	.070	.180	.189	.179
21	.030	.027	.401	.199
22	-.056	.255	.441	.644
23	-.013	.112	.639	.309
24	-.007	.162	.614	.463
25	.103	.187	.863	.203
26	.246	.144	.741	.273
27	.239	.305	.177	.075
28	.231	.268	.391	.235
29	.437	.634	.182	.348
30	.175	-.070	.643	.416
31	.559	-.220	.370	.393
32	.339	-.053	.444	.221
33	.118	-.113	.223	.792
34	.029	.911	.103	-.048
35	.039	-.023	.154	.130
36	-.029	.930	.163	.059
37	.009	.478	.339	.480
38	.241	.125	.564	.392
39	.435	.231	.393	.338
40	.248	.437	.492	.234
41	.385	.297	.233	.572

In Hypothesis II, it was indicated that the combination of designated subtests would result in a higher predictive validity for the Arithmetic Achievement Criterion Score than any single individual or group test. The analysis indicated that the AACS was predicted with a higher validity by an individually administered test than by the combination of subtests.

In Hypothesis III it was stated that the specified subtests would result in higher validity for the Reading Achievement Criterion Score than any single individual or group test. The analysis of data resulted in a higher validity for two individual and one group test than for the multiple correlation resulting from the combined subtests.

In Hypothesis IV it was indicated that the combination of specified subtests in Hypothesis I would demonstrate higher predictive validity than the combination of learning tasks. Hypothesis IV was supported.

In Hypothesis V, it was indicated that the overall achievement of young institutionalized EMR's would be predicted with higher validity by a regression equation developed by submitting all predictor subtests to a multiple regression analysis than by any single individual or group test. The analysis did result in an equation which demonstrated a higher validity than any single individual or group test.

Discussion

Descriptive Data

A review of the descriptive data was made to facilitate discussion. Mean age equivalents on the S-B, PTI, and SIT were significantly higher than the mean age scores of the WPPSI V, FS, and ITPA. The depressed language facility of the retardate may have contributed to the relatively low scores on the WPPSI V, FS, and ITPA. Similar results for the ITPA were reported by Mueller (1965).

The mean of the PMAT of 76 months was significantly higher than all other age equivalent scores. The relatively high PMAT mean may have been the result of the test "floor". Since the PMAT's used were for grades two to four and the mean mental ages of the subjects were more similar to those of first graders, an insufficient number of items at the lower level of the test might have partially inflated the scores. This condition combined with the opportunity to obtain lower age scores on the other predictive measures would lead to higher PMAT scores. Similar effects were reported by Mueller (1965); however, the use of the subtest median in the analysis was attributed by Mueller as another possible contributor to the difference. In the present study the mean subtest score was used in the analysis.

The lower age equivalents in such tests as the WPPSI and ITPA have been attributed to the reliance upon verbal communication and language facility. (McCarthy, 1964) For mentally retarded youth scores on language type tests are expected to be depressed. The limited use and need for verbal communication in an institutional setting might be a partial contrubutor to the limited language facility.

An important factor warranting comment is the mean gain score concept as a criterion measure. The mean standard gain scores reported indicated moderate gains by the subjects in overall, arithmetic, and reading achievement on both the WRAT and the NYAT. The achievement levels attained ranged between the prekindergarten and the low third grade levels (Pk.2 - 3.2) on the WRAT. Gain scores on the WRAT subtests ranged form a minus 16 to a plus 11 and a total test mean gain score of 17. The means reported were below the level reported for the standardized populations on both criterion test batteries. The stability of the achievement scores is indicated by pre and post correlation coefficients for subtests from the WRAT and the NYAT. Coefficients yielded for WRAT subtests were Reading, .82; Spelling, .81; and Arithmetic, .85; and Core, .84. The effects of institutionalization and limited intellectual ability of the sample appear to be factors affecting the scores. The lack of social experiences of the subjects and the bias of the NYAT toward the environment of New York City might help explain the low mean scores. An artifact of the regression effect may have had an effect on the gain scores as posttest results regressed toward the mean. Students who scored relatively high on the pretest would have a more difficult time gaining educationally when approaching their learning capacity than younger students. The above notions indicate that the moderate correlations achieved in this study may have been higher and more significant had the criterion measure been characterized by a greater range and variability.

Means and standard deviations on the three learning tasks indicate a relatively normal distribution. The three tasks appeared to differentiate between subjects and may have limited utility in the prediction of achievement. The moderate test-retest reliability coefficients and correlations with criterion measures reported for the total sample indicate relatively low stability. Due to their novel and game-like nature the learning tasks were enthusiastically received by the young age group. This acceptance and the short administration time required for the tasks may indicate an area for further investigation.

Correlation Analyses

The primary purpose of this study was to evaluate the combination of subtests from various tests as predictors of achievement when compared to single individual or group tests. Learning tasks as predictors of achievement were also to be evaluated in similar comparisons. Correlational analyses were made utilizing the age equivalents and IQ's from the predictor tests and the combined subtest and learning task scores as separate predictor measures. Comparisons of the predictor measures were made as they related to the overall, arithmetic, and reading achievement of young educable mentally retarded children.

The highest correlations with gain scores reported indicate moderate findings on each of the established criteria. Predictor measures yielding the highest correlations with the overall achievement criterion were the SIT IQ, PTI IQ, and the weighted subtest combinations for CPS1 in descending order of correlational magnitude (Tables 2 and 3). The R from the CPS1 correlated significantly more highly than either the QT or PMAT mental ages. The lower correlations of age equivalent scores on all the tests and both age equivalent and IQ on the Quick Test indicate the partial effects of many factors. The limited range of gain scores accounts in part for the age equivalents not correlating more highly with the achievement criterion measures. Depressed language facility with the retarded may account for the relatively low correlation demonstrated by the ITPA. The floor effect on the PMAT may have resulted in spurious scores and a lower correlation with the overall criterion measure. With the moderate correlations indicated, interpretations must be cautious, since the probability of chance occurrences increases as the correlations decrease.

Correlations of the predictor measures with the arithmetic criterion were moderate, accounting for only a small percentage of the variance in the criterion of arithmetic achievement. The SIT and the CPS2 age equivalents indicated significantly higher correlations with the RACS than either the QT or PMAT mental ages. Most predictor tests correlated with the reading criterion at a relatively low level. An investigation of the raw data indicated a skewed distribution with a majority of the scores at the lower range of the continuum. Predictor measures, which had correlated moderately with the overall and arithmetic criteria, demonstrated reduced correlations with reading achievement. The low correlations of predictor tests with reading achievement were consistent with those found by Moss (1962) and Mueller (1965). Both were studies with young educable retardates which would indicate the likelihood that differences do exist in the predictive validity of measures at various chronological and mental age levels. It would appear that during the initial stages of reading a low correlation between reading achievement and general mental ability exists for mentally retarded subjects. The change in the type of items used to measure reading achievement, from letter matching and calling to word naming and comprehension, might cause students with limited ability to achieve at the same level, resulting in limited variability and low correlations. Reed (1958) also reported that qualitative differences existed between reading at the first grade and higher grade levels.

The validity coefficients recorded between IQ's and criterion scores were generally higher than validity coefficients for age equivalents from the same tests and criterion scores. This is contrary to most of the reported findings which indicate the mental age to be the better predictor. Apparently the IQ span was large enough for subjects in this sample so that brighter subjects earned larger gain scores within the entire span of chronological age. If composite predictor scores from several tests could be developed to indicate level of brightness, as when subtests of one test are combined to obtain an IQ, even better predictions may be made. Evidence of this interpretation is found with the analysis of data for Corollary I. Within small chronological age spans the R's for criterion scores and the five predictor subtest combinations (See Tables 11, 12 and 13) were appreciably higher than with the overall range, i.e., .78 for Age Group One, .74 for Age Group Two, and .59 for Age Group Three, as compared with .52 for the entire age span. An evaluation of this interpretation cannot be continued until a dimension of "brightness" can be attributed to the subtests combined in the multiple regression analysis. Such a combination was not proposed for this study. The deriving of a "brightness quotient" by dividing the mean subtest age by the CA would be assumed to produce a higher R coefficient. This factor warrants further evaluation and investigation.

The evaluation of the learning tasks as predictors of achievement was not as promising as was suggested by the review of the literature. The Coding and PAT resulted in low correlations with the criterion measures. The OLT demonstrated moderate correlations with the overall and reading criteria and showed a higher validity with the reading criterion than some of the individual tests. OLT test-retest reliability coefficients were low. The fact that the OLT can be administered in a very few minutes suggests that increasing its length may improve its reliability and its validity. Since the subjects appeared to be highly interested in the OLT further investigation with its use is warranted.

Multiple Regression Analyses

A number of multiple regression analyses were completed to obtain a parsimonious combination of tests and subtests for the prediction of the three criterion measures. Combinations of subtests and learning tasks set forth in the hypotheses were evaluated in terms of the most practical and efficient combinations achieving the optimal predictive level.

Results of the multiple regression analysis carried out with the subtests in Hypothesis I indicated the Picture Vocabulary subtest from the PTI to be almost as effective when used alone as when utilizing the additional four subtests. The additional four subtests did not enhance the .507 multiple correlation of the Picture Vocabulary subtest appreciably. Use of this subtest alone demonstrated as high a relationship to the overall achievement criterion as any single individual or group test score, with the exception of the SIT IQ. Even though the subtest compared favorably with other predictor tests the results indicate only a moderate degree of relationship to the OACS.

Separate multiple regression analyses were carried out for each of the three age groups. Results of the analyses indicated that the combination of subtests demonstrated a higher validity for the young age group than for either the middle or older age group. The R's of .779 for the youngest group, .740 for the middle age group, and .588 for the oldest group indicate the difference in the degree of relationship across various age groups. With such differences, consideration must be given to the predictive validity of various tests and subtest combinations with specific age groups. The trend for higher correlations for the young group might partially be a result of a plateau in the achievement levels of the older subjects. The better predictors of achievement for the oldest group were subtests which can be administered to groups of subjects, wheras individually administered tests were better predictors at younger ages. Perhaps individually administered tests other than those used in this study would be more effective with the older subjects. Investigations designed to evaluate these implications could result in improved procedures for the testing of educable mentally retarded children.

The multiple regression analysis of subtests to predict the arithmetic criterion yielded the Auditory-Vocal Association subtest from the ITPA and the Arithmetic subtest from the WPPSI as the best predictors. The addition of the Size and Number (PTI) and Number Facility (PMAT) subtests produced a minimal increase in the R. The use of subtests from different tests is not a common practice; however, in cases where the subtest combinations exceed the validity of single tests the practice should be implemented. Since there were single tests which demonstrated a higher relationship with the AACS than the combination of subtests, the above results suggest little utility. A slight advantage in the brevity of time required to administer the subtests would be realized over most of the total tests; however, the time would be approximately equal to that required by the SIT.

The analysis to determine the regression equation for subtests in Hypothesis III revealed the Auditory-Vocal Association subtest from the ITPA as the best remaining predictor from the four analyzed. The possible qualitative difference in reading achievement at various mental ages would tend to lower correlation of tests measuring a general mental ability. The Auditory-Vocal Association subtest emerged in the study by Mueller (1965) as one of three subtests which effectively predicted learning ability. The subtest might be better utilized with older EMR's where the reading achievement is more affected by language development.

Since another purpose of this investigation was to determine the optimal predictors of the overall achievement criterion, two additional multiple regression analyses were carried out. The submission of all subtests to an analysis indicated that the three best predictor subtests for the total age span were the Immediate Recall (PTI), Auditory-Vocal Automatic (ITPA), and the Auditory-Vocal Sequencing (ITPA). The measuring of short term retention by the Immediate Recall and Auditory-Vocal Sequencing appeared to account for a large portion of the criterion measure. The addition of the Auditory-Vocal Automatic subtest reflected a slight gain in the multiple correlation as it appeared to measure language structure. The inclusion of the WPPSI Arithmetic subtest and the Coding A produced small increases in the R. Both subtests again reflect a memory component present in prior mentioned subtests. The inclusion of the Perceptual Speed subtest from the PMAT contributed a moderate increase to the multiple correlation and introduced the learning component of perceptual ability. The three major components indicated for the learning ability of institutionalized educable retarded children in this study were memory, verbal, and perceptual abilities. The emergence of these components may be related to the curricula for EMR's since in many programs much emphasis is put on the retention of facts, language development, and perceptual training in readiness for reading. The components might have emerged as a result of the criterion measures being slightly biased toward the memory, language, and perceptual components.

Factor Analysis

The four factors interpreted from the factor analysis were based upon the principal axis solution and the varimax rotation. After the interpretation of the strong general factor, subsequent factors were not readily identified. The salient general factor, identified as the General Mental Ability factor, is similar to the General Academic Achievement factor reported by Mueller (1965). Loadings ranged from .38 to .93 for the 41 variables in the study and are similar to the range of .37 to .92 reported by Mueller. Most subtests and tests obtained high loadings on the general factor. Notable exceptions were the PAT and WRAT reading scores. Tests and subtests with the highest loadings on this factor were the S-B MA, SIT MA, Arithmetic subtest from the NYAT, and the

Information subtest from the WPPSI. The preponderance of loadings of other variables were from moderate to high, indicating the commonality in the measures.

Factor II was interpreted as Symbol Recognition. The factor requires recognition and recall of visual symbols. High loadings on the PAT, WRAT Reading, and Verbal Meaning (PMAT) indicate a similar characteristic of recognizing the symbol and recalling either its name or use. Achievement of EMR's in the initial stages of their education appear related to symbol recognition and recall. The low correlations of most predictor tests with reading achievement may be attributed to the inability of the tests to measure the recognition and recall factors inherent in the function of reading.

The factor of Short Term Memory, as Factor III, was interpreted from high loadings by Visual-Motor Sequencing from the ITPA, Geometric Design, Block Design, and Arithmetic from the WPPSI. Moderate loadings on the factor included the measure of Form Discrimination and Immediate Recall from the PTI, arithmetic subtests from the WRAT and NYAT, and the Perceptual Speed subtest from the PMAT. Each of the above measures involve a retention component. A perceptual component was reflected in many of the measures; however, the memory component was interpreted as the major factor.

Factor IV, characterized by tests involving the association of visual symbols, was termed the Visual Association Factor. High loadings by the Coding subtest and moderate loadings by the

Animal-House and Mazes subtests of the WPPSI, Spatial Relations from the PMAT, WRAT Spelling subtest, and NYAT core subtest support the interpretation of the Visual Association factor. Again, a perceptual component was suggested; however, the loadings indicated a factor characterized specifically by visual association.

Factor I accounted for 55 percent of the explained variance with Factors II, III, and IV explaining an additional six percent, four percent and four percent respectively. The high loadings on the general factor indicate a high degree of interdependence with the measures used. Slight independence in the measures can be noted by the factors identified as those explaining a considerably smaller portion of the achievement of young institutionalized EMR's.

The results of the correlation, multiple regression, and factor analyses were reported in this chapter. Further interpretation and discussion of the results were also presented. Chapter V will include the summary, conclusions, implications, and recommendations from the study.

Chapter V

SUMMARY, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

Summary

This study was designed to evaluate the combination of specific subtests as predictors of achievement with institutionalized educable mentally handicapped children. Six individually administered tests, one test suitable for group administration, and three learning tasks were used to determine the utility of a battery or partial test battery approach when compared to the single or global score prediction of achievement. Tests used as predictors were the Stanford-Binet, Illinois Test of Psycholinguistic Abilities, Pictorial Test of Intelligence, Wechsler Preschool and Primary Scale of Intelligence, Quick Test, Slosson Intelligence Test, and the Primary Mental Abilities Test. Learning tasks included as predictor measures were the Coding subtest from the WISC, a paired associate task, and an order learning task. Multiple criteria of gain scores on the WRAT and the NYAT subtests were used as criterion measures.

The sample included in the analyses was comprised of 51 children enrolled in the educational program at The Pennsylvania State University Demonstration School at the Cresson State School and Hospital, Cresson, Pennsylvania, and the educational program at the Selinsgrove State School and Hospital, Selinsgrove, Pennsylvania. The subjects ranged in CA from 6-7 to 12-6 at the beginning of the study. The IQ range for the subjects was 50 to 75.

All 51 subjects received the total pretest battery of six individual tests, one group test, three learning tasks, and the criterion achievement measures of three subtests each from the WRAT and the NYAT. Following a period of seven months the learning tasks, WRAT, and NYAT were readministered to obtain the posttest data. Criterion scores were obtained by computing gain scores for overall, arithmetic, and reading achievement. Subsequent statistical analyses were performed to evaluate the following hypotheses:

Hypothesis I: Overall achievement of young institutionalized EMR's, IQ 50-75, will be predicted with higher validity by a regression equation based on the combination of the Auditory-Vocal Association and Auditory-Vocal Automatic subtests from the ITPA, the Picture Vocabulary subtest from the PTI, and the Number Facility and Perceptual Speed subtests from the PMAT, (CPS1), for all age levels, than by any single individual or group test.

Corollary I: The combination of subtests described in Hypotheses I will demonstrate higher predictive validity with the 6-7 to 8-6 year level than with the 8-7 to 10-6 or 10-7 to 12-6 year levels.

Hypothesis II: Arithmetic achievement of young institutionalized EMR's, IQ 50-75, will be predicted with a higher validity

validity by a regression equation based on the combination of Auditory-Vocal Association (ITPA), Size and Number (PTI), Arithmetic (WPPSI), and Number Facility (PMAT),(CPS2), than by any single individual or group test.

Hypothesis III: Reading achievement of young institutionalized EMR's, IQ 50-75, will be predicted with a higher validity by a regression equation based on the combination of Auditory-Vocal Association and Visual-Motor Sequencing (ITPA), Form Discrimination (PTI), and Number Facility (PMAT), (CPS3), for all age levels, than by any single individual or group test.

Hypothesis IV: Overall achievement of young institutionalized EMR's, IQ 50-75, will be predicted with higher validity by a regression equation based on a combination of subtests in Hypothesis I than by the Coding (WISC), PAT, and Order learning Tasks (OLT) combined (CLTS).

Hypothesis V: Overall achievement of young institutionalized EMR's, IQ 50-75, will be predicted with higher validity by a regression equation developed from a multiple regression analysis of selected subtests than by any single individual or group test.

The data were analyzed by use of correlation and multiple regression techniques to determine the validity of the various predictor measures and subtest combinations when compared to the criteria of overall, arithmetic, and reading achievement. A factor analysis of selected variables was also made.

Hypothesis I was supported since the combination of proposed subtests achieved a higher predictive validity of the OACS than any single individual or group test. The higher validity demonstrated was not significantly different from other predictor tests with the exception of the QT and the PMAT.

Corollary I was also supported because the subtest combination resulted in a higher R for Age Group One than for either Age Group Two or Age Group Three. The Predictive validity of the R for Age Group One was significantly higher than the R for Age Group Three.

Hypothesis II was not supported by the results since the SIT MA score indicated a higher validity in predicting the AACS than the specified subtests. The observed difference was not statistically significant.

The combination of subtests to predict the RACS in Hypothesis III was not supported by the data. The validity coefficients obtained for the S-B and PMAT exceeded the R of the designated subtests to be combined. The observed differences were not statistically significant.

Hypothesis IV was supported by the analysis, since the R of the combined subtests in Hypothesis I was higher than the R resulting from the combination of learning tasks.

The R resulting from a regression analysis of selected subtests demonstrated a higher validity than that from any single individual or group test, which supported Hypothesis V.

The results indicated the optimal single channel predictor of the OACS to be the Immediate Recall subtest from the PTI. Additional single channel tests in descending order of contribution to the R were the Auditory-Vocal Automatic and Auditory-

Vocal Sequencing from the ITPA, Arithmetic from the WPPSI, The Coding from the WISC, and the Perceptual Speed subtest from the PMAT. Multiple regression analyses indicate verbal, memory, and perceptual speed to be important components in the achievement of institutionalized educable mentally handicapped.

A principal-axis factor analysis and the orthogonal rotation of yielded factors for 33 selected variables was performed. Four factors were interpreted and identified as General Mental Ability, Symbol Recognition, Short Term Memory, and Visual Association. The factor of General Mental Ability accounted for 55 percent of the variance while the remaining factors accounted for six percent, four percent, and four percent of the variance, respectively. Three of the identified factors were similar to those reported by Mueller (1965).

Conclusions

The conclusions which may be drawn on the basis of this study are as follows:

1. Subtest combinations of Auditory-Vocal Automatic and Auditory-Vocal Association from the ITPA, Picture Vocabulary from the PTI, Number Facility and Perceptual Speed from the PMAT, is a regression equation resulted in a higher validity than any single individual or group test in the study when compared to the overall achievement criterion score.

2. Differences of test validity at various age levels do

exist, since the above subtest combinations resulted in a higher validity coefficient for Age Group One than for either Age Group Two or Age Group Three. A significant difference between the R's of Age Group One and Age Group Three was found.

3. Subtest combinations of Auditory-Vocal Association and Visual-Motor Sequencing from the ITPA, Form Discrimination from the PTI, and Number Facility from the PMAT, in a regression equation, do not predict the arithmetic achievement criterion with a higher validity than any single or individual test in the study since they were exceeded by the validities of the SIT and S-B mental ages.

4. Reading achievement is not predicted with a higher validity by a regression equation of the Auditory-Vocal Association and Visual-Motor Sequencing subtests from the ITPA, the Form Discrimination subtest from the PTI, and the Number Facility subtest from the PMAT than by any single individual or group test in the study, because the S-B mental age score and the PMAT mean subtest age score demonstrated higher validity coefficients than the R yielded by the subtest combination.

5. A regression equation based upon the Immediate Recall subtest from the PTI, the Auditory-Vocal Automatic and Auditory-Vocal Sequencing subtests from the ITPA, and the Arithmetic subtest from the WPPSI predicted the overall achievement criterion score with a higher validity than any single or individual group test included in this study.

6. The best single channel predictor test of all those included in the study was the Immediate Recall subtest from the PTI.

7. When using the same predictor measures with consecutive age groups differences of test validities exist.

8. Learning tasks did not demonstrate sufficient stability to warrant a conclusive statement pertaining to their effectiveness as predictors of achievement.

Implications

There are several implications to be drawn from the results of this study. One implication pertains to the common practice of using a group test and an individual test for the educational placement of EMR's. The placement of institutionalized children in educational programs may be improved by more efficient use of selected tests. The results of this study suggests the use of a short, individual screening test, such as the SIT or the Immediate Recall subtest from the PTI, followed by the administration of an individual test.

Support for the use of subtests from different tests in the study suggests that the use of scores based upon the total test may not yield a high enough pay off for the time expended. Unless a single test has demonstrated high validity, a more desirable precedure for evaluation and prediction may be to use a combination of subtests selected from several tests.

The relatively low correlations of the predictor tests with the reading criterion indicates a need to develop instruments to measure the components in the reading function at the level of the sample. The qualitative differences in the reading process with young institutionalized EMR's will require new measurement instruments.

Differences in the validity of predictor subtest combinations indicate a need to re-evaluate predictive instruments with regard to age ranges. The method of measuring achievement using instruments highly loaded on a general mental ability factor has not indicated utility with young institutionalized educable retardates. The use of such instruments with a population of this type may lead to limited effectiveness of learning prediction.

Recommendations

1. It is recommended that the predictor tests and subtest combinations in this study be re-evaluated with a larger sample, particularly from similar settings.

2. This study should be replicated with more extensive and refined achievement measures in the specific subject areas. Since the multiple criteria appears adequate, additional measures may provide more refined measures of change and better measures of the objectives of instruction.

3. Further study using the learning tasks as predictors of achievement should be considered. Some attention may be given to their use in studies concerned with the establishment of

of rapport prior to initiating formal testing and their effects on test results. Improving the reliability of the learning tasks may improve their effectiveness.

4. A followup study in two or three years should be considered to validate the predictor tests used over a period of time allowing for extended educational achievement.

5. A study should be undertaken to evaluate the subtest combinations yielding R's when a "brightness" factor can be derived comparable to the IQ.

6. This study should be replicated using the pretest data, gain scores, and posttest data as criterion measures to evaluate the stability of the predictor measures across the three criterion references.

7. A study utilizing predictor measures with children who have not been exposed to an educational program should be considered.

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APPENDIX A

Instrumentation

Instrumentation

For purposes of the study the following psychometric instruments and learning tasks were designated as predictors of achievement: Stanford-Binet Intelligence Scale, Illinois Test of Psycholinguistic Abilities, Pictorial Test of Intelligence, Wechsler Preschool and Primary Scale of Intelligence, Quick Test, Slosson Intelligence Test for Children and Adults, Primary Mental Abilities Test, Coding A, Paired Associate Task, and an Order Learning Task. Achievement criterion measures were the Wide Range Achievement Test and the New York Achievement Test for Mentally Retarded. The instruments are described more fully on the following pages.

1960 Stanford-Binet Intelligence Scale

The S-B is a standardized, individual, intelligence test grouped into age levels according to difficulty ranging from age two to superior adult. The test yields scores of a mental age and deviation IQ's. Test performance items range from a simple manipulation of objects to abstract reasoning with the test being essentially verbal in nature. Reliability and validity of earlier test editions have been extensively studied and are reported as adequate by the authors. Reliability and validity studies have been presented in the preliminary review of the literature. Validity in predicting achievement has been reported as generally good. (Mueller, 1965) Himelstein (1968) in a review of recent research of the S-B with young retardates concluded the test-retest reliability to be adequate for the young retardate. On the basis of the wide acceptance of the S-B the test was included in the present study. The test should serve as an adequate comparative measure to the hypothesized test combinations. The wide usage of the test (Silverstein, 1963) indicates the need for its inclusion in the current study.

Illinois Test of Psycholinguistic Abilities

The ITPA is an individually administered test designed to identify psycholinguistic abilities and disabilities in children between the ages of two and one-half and nine. The test is based on a communication model by Osgood (1957). Dimensions of psycholinguistic abilities are measured by six tests at the representational level requiring comprehension and giving meaning to symbols used in communication. The subtests are Auditory Decoding, Visual Decoding, Auditory-Vocal Association, Visual-Motor Association, Vocal Encoding, and Motor Encoding. Subtests evaluating abilities at the automatic sequential level provide measures of automatic habits which produce syntactical and inflectional aspects of language and the ability to remember a sequential structure. These subtests are Auditory-Vocal Automatic, Auditory-Vocal Sequencing, and Visual-Motor Sequencing. The tests yield age equivalent and standard scores on total language functioning and on each of the nine subtests. The test was standardized on a group of 700 children of average intelligence. The test has been used extensively with mentally retarded many of which are reported in the preliminary review. The identification of psycholinguistic abilities of the mentally retarded indicate the utility of the test in predicting the educational development of EMR's. The finding that scores from the ITPA reflect the academic performance of mentally retarded to a greater extent than MA scores for the same children necessitated its inclusion for further research.

Pictorial Test of Intelligence

The PTI was designed to provide an easily administered, objecttively scored, individual test for assessing the general intellectual level of children ranging in age from three to eight. Items are divided into six subtests: Picture Vocabulary, Form Discrimination, Information and Comprehension, Similarities, Size and Number, and Immediate Recall, and are presented in order of difficulty within each subtest. All responses by the subject are made by indicating one of four symbols on a large response card which represents the answer to various stimulus questions. The test purports to measure general mental ability in terms of factors which include verbal comprehension, numerical computation, perceptual organization, memory and reasoning. Standardization of the PTI was accomplished on a total of 1830 subjects. The standardization sample selection was based on the 1960 Census data as to regional area, community size, and occupational level of the father. Reliability estimates for the full scale range from .87 to .93 for various age levels. Validity coefficients ranged from the high 50's to the low 80's when correlated with the results of other intelligence tests. Correlations of .72, .65, .53 with the S-B, WISC, and Columbia Mental Maturity Scale respectively are reported by the author. (French, 1963) The age range of three to eight suggests this instrument's suitability for use with young EMR's. The appeal of the items and format as well as the reliability and validity coefficients indicated justification of the test in the study. Even though the age being studied (6-6 to 12-6) is beyond the standardization sample the author suggests and Mueller (1965) verifies that the test is suitable for use with retarded individuals beyond the CA range of the test.

Wechsler Preschool and Primary Scale of Intelligence

The WPPSI is an individually administered intelligence test designed to appraise the abilities of the preschool child between the ages of four and six and one-half. The WPPSI is a downward revision of the WISC and is a separate and distinct scale even though it is similar to the WISC in form and content. The test consists of a battery of subtests, each of which when treated separately may be considered as measuring a different ability, and when combined into a composite score as a measure of overall global intellectual ability. The test battery is divided into a composite score as a measure of overall global intellectual ability. The test battery is comprised of Information, Vocabulary, Arithmetic, Similarities, Comprehension, and a supplementary Sentences subtest. Performance group subtests are Animal House, Picture Completion, Mazes, Geometric Design, and Block Design. Verbal, Performance, and Full Scale IQ scores are computed as well as test age equivalents. The standardization sample consisted of 100 boys and 100 girls in each of six age groups ranging by half years from four through six and one-half. The sample was stratified, on the basis of the 1960 Census, on variables of age and sex, geographic region, urban-rural residence, race and father's occupation. Correlation with other measures of intelligence are few due to the recent publication of the test. WPPSI Verbal (V), Performance (P), and Full Scale (FS) IQ's correlate .76, .56, and .75 respectively with the S-B. Correlations of V, P, and FS IQ's of .53, .60, and .64 respectively with the PTI are reported. The limited validity of the WISC with young EMR's and the need to evaluate the validity of the WPPSI with this population provide reason for the inclusion of the test in the present study. The age range of the population in the proposed study was beyond the age range of the test standardization; however, the author indicates the test can be used with retarded individuals whose CA's extend those of the standardization group. For this group age equivalents were used in the analysis of data.

Quick Test

The QT is an individually administered intelligence test in three forms based on perceptual-verbal performance. The test takes three to ten minutes to administer ranging in ability levels from the two year level to the superior-adult level. Subjects respond by indicating one of four pictures representing a correct response to a stimulus word. Three plates, each with four line drawings on it, are used; one plate for each of the three 50 item forms. Quick test standardization was accomplished on a total of 458 children and adults. The sample was controlled on a simultaneous quota basis for age, sex, educational level, and own or father's occupation. Reliabilities of single forms are reported by the author as being high. Reliabilities for various groups are reported as follows: preschool age interform, .78; predicted two-form, .87; predicted three-form, .92; special group interform, .61; predicted two-form, .76; predicted three-form, .82. Other reliability coefficients range from .60 to .95. Validity determined by comparison with other intellectual measures yield correlations of .76 and .77 with Form One and Two of the Full Range Picture Vocabulary. The author reports the Quick Test correlates significantly with school grades and achievement measures; however, the source of the correlations were not reported. This test was included in the study due to the ease and brevity of administration and to determine the validity of test for use with educable mentally retarded.

Slosson Intelligence Test

The SIT is an individually administered intelligence test which was designed to function as a screening instrument for children and adults. The range of age levels covered by the test is from two weeks to the adult level. Test items are patterned closely to those of the S-B and Cattell Infant Intelligence Scale. Items are primarily verbal with some motor and counting items included at the lower age range. A mental age and ratio IQ can be obtained. Reliability reported by the author for test-retest intervals within two months was .97. Subjects for the reliability study were between the ages of 4 and 50. Validity for the SIT was indicated by a comparison with the 1960 S-B. Coefficients between .90 and .98 are reported for each age level between 4 and 17 with a correlation of .97 reported for subjects 18 and above. The standardization of the SIT is vaguely reported in general terms. Reliability and validity studies are reported by the author only, indicating the need to determine the validity of the test with specific populations before it is used extensively. The test has been considered for inclusion in this study due to the reported high validity with the S-B and the attempt to establish its utility for use with educable mentally retarded.

Primary Mental Abilities Test

The PMAT is designed to provide both multi-factored and general measurement of intelligence. The 1962 revision of the test consists of five levels yielding four to five specific scores depending on level, as well as a general or total test IQ. The form designed for grades two to four were utilized in this study. This form consists of Verbal Meaning, Spatial Relationship, Number Facility, and Perceptual Speed subtests. The test is designed for group administration and generally requires approximately one hour to be completed. The PMAT was standardized on a group of 31,919 students from kindergarten through grade twelve, stratified on the basis of regional location and school size. Stability estimates are reported by grade level with test-retest intervals of one and four weeks. Median values over all grade levels were: total score, .91; Verbal Meaning, .89; Spatial Relationship, .78; Number Facility, .81; Perceptual Speed, .67; and Reasoning, .83. Median values for level 2-4, which were used in this investigation were: total score, .92; Verbal Meaning .86; Spatial Relations, .77; Number Facility, .88; and Perceptual Speed, .80. Predictive validity of PMAT IQ was evaluated in a comparison of school grades after a lapse of 14 months with reported coefficients ranging from a low of .03 to .74. The validity for the 2-4 grade range seemed most appropriate for use in the study. Median coefficients at this level were: total score, .53; Verbal Meaning, .40; Spatial Relations, .30; Number Facility, .56; and Perceptual Speed, .46. The PMAT was included for reasons of the use of the group test in an educational setting and the need to include at least one group test of intelligence in the study.

Coding Task

The Coding A was used in this study as a learning task. The task was taken from the WISC and included as one test requiring the subject to learn and perform within the test situation. The subject was required to associate paired symbols and write down a correct identification mark associated with the model symbol. Five figures provided the model symbols, and each was associated with an independent response. The subject had two minutes in which to complete the presented items. The coding task was presented twice to minimize imitative reproduction and increase the learning of the symbols. Total number of correct responses on both trials were converted to standard T scores for the analysis.

The Coding A test standardized as part of the WISC battery on a sample of 300 subjects. Alternate test reliability yields a coefficient of .60. Throne et al. (1962) report a test-retest reliability of .83 on a sample of 39 retarded boys. The test was included in the study as a learning task in which learning within the situation could be demonstrated. In learning to associate an identification mark with a symbol, demonstrated learning could be measured. The task was used to evaluate the predictive effectiveness of learning tasks as proposed by Denny (1964). (The description of this test and those following are basically the same as those reported by Mueller (1965) with some modifications and additions made).

Paired Associate Task (PAT)

The PAT consisted of five pictures of animals to be matched with digits numbered from one to five. The pairs of pictures and numbers were presented using a University Microfilm Incorporated, Model 120, portable microfilm reader. Pictures of animals were projected on the microfilm reader. The purpose of the PAT was to obtain a measure of learning through the number of associations learned. The pictures of the animals were presented once to confirm that the subject could identify each picture and name each response numeral. The pictures and order of presentation are presented in Appendices B and C. The test proceeded with a presentation of a stimulus picture, without the number, for a five second interval during which the subject response was made. Following the five second interval and response, the stimulus picture with the correct response was shown. Verbal response was used to reinforce a correct response when the picture appeared. The pictures were presented in a series of five randomizations to control for possible serial learning effects. Criterion for each subject was five correct responses through a complete series of five pictures or through nine complete presentations of a series, whichever occured first. The total number of correct responses comprised the score with trials following the attainment of criterion scored as correct responses. Directions to be used by the examiner in the administration of the PAT were as follows:

> Set up the microfilm reader so that image fills screen as nearly as possible. Seat subject directly facing screen of the microfilm reader and fill out information test sheet. Give the following directions:
>
> __(name)__, I WANT YOU TO WATCH THE SCREEN WHILE I SHOW YOU SOME PICTURES. EACH ONE HAS A PICTURE OF A DIFFERENT ANIMAL. FIRST WE WILL SEE EACH ANIMAL MATCHED WITH ITS NUMBER. AS I SHOW EACH PICTURE, YOU SAY THE NUMBER THAT GOES WITH EACH ANIMAL. (Show first group of pictures without further comment).

SERIES 1. NOW WHEN THE PICTURES ARE SHOWN THEY WILL NOT HAVE A NUMBER WITH THE PICTURE OF THE ANIMAL. WHEN YOU SEE A PICTURE OF AN ANIMAL, I WNAT YOU TO TELL ME QUICKLY WHICH NUMBER GOES WITH THAT ANIMAL, AND I WILL WRITE IT DOWN. THEN THE PICTURE WILL COME ON WITH THE ANIMAL AND THE NUMBER AND WE WILL SEE IF YOU GAVE ME THE RIGHT NUMBER. BE SURE TO TELL ME THE NUMBER QUICKLY BEFORE THE PICTURE WITH THE ANSWER COMES ON. (Continue through second series of pictures or until subjects gets every picture correct in any one series of five. Verbally reinforce each response when the response picture appears. Correct any errors which occur in the first 10 trials. Encourage subject to respond before the second pair appears if necessary).

Order Learning Task (OLT)

The OLT was adminstered using a bell ringing apparatus (BRA). A schematic drawing of the bell ringing apparatus is shown in Appendix D. The subjects were presented with a 10" x 14" panel housing three standard doorbell buttons. The task was to press one of the three buttons one of which was always correct. To be consistently correct it was necessary for the subject to press the buttons in order from left to right. A correct order of response was the depressing of the button to the left of the examiner and progressing in order to the middle and right buttons. A reinforcement of a bell sound, controlled by the examiner, was used with each correct response. An interval of approximately three seconds between trials was maintained with 15 second intervals between each block of nine trials. Criterion was nine consecutive correct responses or a total of 45 trials whichever occurs first. The raw score was the total number correct with trials remaining beyond criterion tallied as correct.

Directions used by the examiner were as follows:

(Fill out test sheet; sit facing the subject with the BRA between the examiner and the subject. Explain the task as follows):

IN THIS TEST YOU ARE TO FIND OUT WHICH OF THE THREE BUTTONS IS THE RIGHT ONE TO PRESS. HERE YOU CAN SEE THREE BUTTONS. ONE OF THEM WILL BE RIGHT EACH TIME I ASK YOU TO PRESS ONE. WHEN YOU PUSH THE RIGHT BUTTON YOU WILL HEAR A BELL (demonstrate), BUT WHEN YOU PRESS THE WRONG ONE YOU WILL HEAR NOTHING (demonstrate). SOMETIMES ONE OF THE BUTTONS WILL BE RIGHT AND SOMETIMES THE OTHER BUTTONS WILL BE RIGHT. YOUR JOB IS TO LEARN TO PRESS THE RIGHT ONE EVERY TIME. WHEN I SAY PRESS, I WANT YOU TO PRESS THE BUTTON THAT YOU THINK IS RIGHT FOR THAT TIME. REMEMBER WHEN YOU PRESS THE RIGHT BUTTON YOU WILL HEAR A BELL, BUT IF YOU PRESS THE WRONG BUTTON YOU WILL HEAR NOTHING. (Testing will begin immediately with the button to the left of the S being the first correct response. The correct response series will be E's left, middle, and right buttons three times for a criterion of nine correct responses. An inter-trial interval of approximately three seconds is to be used. A 15 second interval should be maintained between each ninth trial. Directions may be repeated if necessary.

Wide Range Achievement Test

The WRAT is an individually administered test of achievement in reading, spelling, and arithmetic, ranging from kindergarten to college in each of the three subtests. Level I used in the study was designed for use with children between the ages of 5 and 12. The reading score is based on the recognition and naming of letters and and the pronouncing of words. Words were presented in order of difficulty and the subject was asked to read through the list until 12 consecutive words were read incorrectly. The spelling test was administered by having the subject copy marks resembling letters, name writing, and writing single words to dictation. The arithmetic tests entailed counting, reading number symbols, solving oral problems, and performing written computations. Altogether, the three subtests took between 20 and 30 minutes to administer. Though a group administration is possible for the arithmetic sections, in the study all subtests were administered individually.

Level I of the test was standardized on a population of 5868 and reliability coefficients were reported by the author to range from .90 to .95 for each subtest with an average reliability of .93. The WRAT has been used as a criterion of achievement in a number of studies of the validity of intelligence tests and has been widely used with the mentally retarded. (Wolfensberger, 1962) The test reports scores from pre-kindergarten levels making it more appropriate for use with mentally retarded subjects. Validity studies have demonstrated correlations of .81, .74, and .84 between reading, spelling, and arithmetic subtests of the WRAT and California Mental Maturity IQ's. (Jastak and Jastak, 1965)

The construct validity and extended range of obtainable scores indicated the appropriateness of including this test as an achievement criterion. The wide acceptance and use of the test by professionals working with EMR's, indicated a need for its inclusion in studies of the retarded.

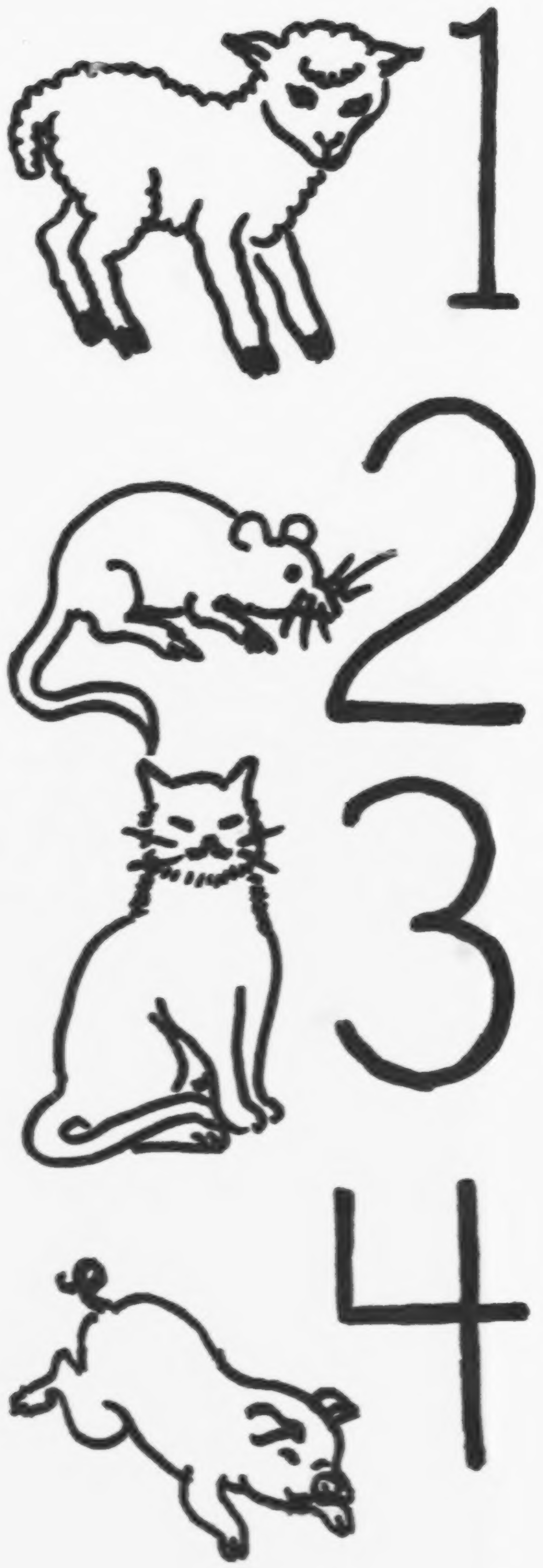
New York Achievement Test

The NYAT is a battery of three tests, the Wide Range Test of Reading Achievement, the Wide Range Test of Mathematical Concepts, and the New York City Core Achievement Test. All of the tests are group administered tests designed to provide measure of development in the mentally retarded. The reading test measures skills of word recognition and meaning, sentence and paragraph comprehension. The mathematical test is designed to measure proficiency in mathematical concepts rather than computational skills. It includes the meanings of mathematical terms and symbols, money problems, time telling by clock and calendar, and practical mathematical problems. The Core test evaluates elements of average daily living skills by evaluating areas of knowledge pertaining to safety, health, personal care, environmental awareness, community travel, and purchasing practical items.

The tests have been standardized on 1000 mentally retarded subjects and percentile norms are reported as tentative. Reliability coefficients for the reading test ranging from .95 to .96; arithmetic, .81 to .85; and core, .79 to .84 are reported. Validity is presented only in the terms of face validity and utility. The tests were included in this study because they were developed specifically for use with the mentally retarded and are the only available tests of their kind.

APPENDIX B

Paired Associate Task Stimulus Pictures


1
2
3
4
5

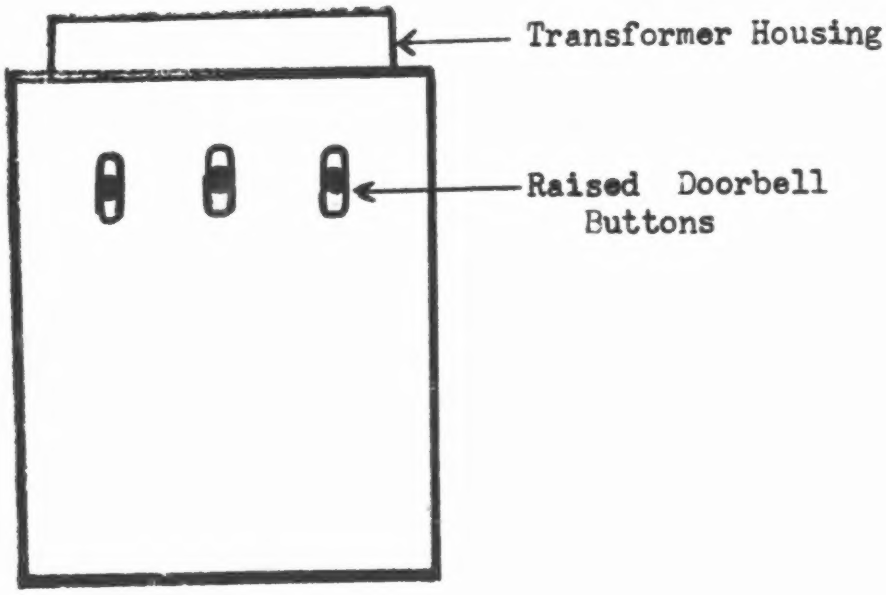
APPENDIX C

Random Order for Persentation of Paired Associate Pictures

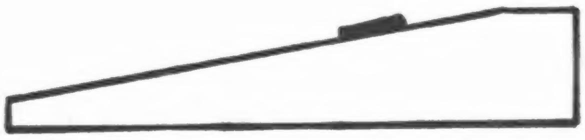
	Trial		Trial		Trial
Series 1	1. Mouse Mouse 2	Series 4	16. Duck Duck 5	Series 7	31. Pig Pig 4
	2. Pig Pig 4		17. Lamb Lamb 1		32. Lamb Lamb 1
	3. Cat Cat 3		18. Pig Pig 4		33. Duck Duck 5
	4. Lamb Lamb 1		19. Cat Cat 3		34. Cat Cat 3
	5. Duck Duck 5		20. Mouse Mouse 2		35. Mouse Mouse 2
Series 2	6. Pig Pig 4	Series 5	21. Cat Cat 3	Series	36. Mouse Mouse 2
	7. Lamb Lamb 1		22. Pig Pig 4		37. Cat Cat 3
	8. Mouse Mouse 2		23. Lamb Lamb 1		38. Lamb Lamb 1
	9. Duck Duck 5		24. Mouse Mouse 2		39. Duck Duck 5
	10. Cat Cat 3		25. Duck Duck 5		40. Pig Pig 4
Series 3	11.Duck Duck 5	Series 6	26. Mouse Mouse 2		41. Duck Duck 5
	12. Pig Pig 4		27. Lamb Lamb 1		42. Pig Pig 4
	13. Mouse Mouse 2		28. Pig Pig 4		43. Lamb Lamb 1
	14. Cat Cat 3		29. Duck Duck 5		44. Cat Cat 3
	15. Lamb Lamb 1		30. Cat Cat 3		45. Mouse Mouse 2

APPENDIX D

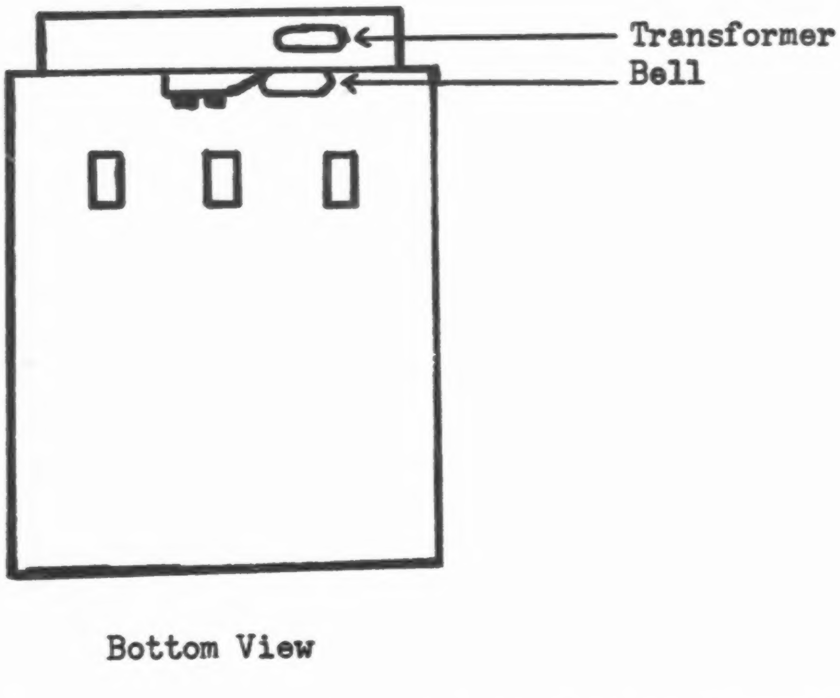
Schematic Drawing of Bell Ringing Apparatus



Top View



Side View



Bottom View

Figure 1. Schematic Drawing of Bell Ringing Apparatus

APPENDIX E

Subjects Excluded from the Study

Reasons for Exclusion from Study

Institution	Reason
Selinsgrove	Subject untestable after second test session
Selinsgrove	Subject untestable after second test session
Selinsgrove	Subject transferred to another institution
Cresson	Subject transferred to another institution

APPENDIX F

Raw Test Data

Raw Test Data

Variable/Subject	1	6	11	16	21
1 Chronological Age	150	128	150	124	104
2 Stanford-Binet MA	104	66	84	76	51
3 Stanford-Binet IQ	72	53	60	61	47
4 ITPA LA	86	61	86	66	49
5 ITPA Auditory-Vocal Automatic LA	96	37	105	73	46
6 ITPA Visual Decoding LA	75	49	108	44	36
7 ITPA Motor Encoding LA	65	46	76	76	60
8 ITPA Auditory-Vocal Association LA	108	66	78	78	50
9 ITPA Visual-Motor Sequencing LA	75	68	81	76	58
10 ITPA Vocal Encoding LA	83	107	72	68	53
11 ITPA Auditory-Vocal Sequencing LA	75	39	75	75	35
12 ITPA Visual-Motor Association LA	94	65	86	78	73
13 ITPA Auditory Decoding LA	106	81	106	46	44
14 PTI MA	90	54	101	68	47
15 PTI IQ	60	43	67	55	44
16 PTI Picture Vocabulary MA	102	54	108	72	48
17 PTI Form Discrimination MA	75	57	108	60	48
18 PTI Information and Comprehension MA	90	45	96	90	46
19 PTI Similarities MA	96	42	90	51	42
20 PTI Size and Number MA	84	63	102	78	54
21 PTI Immediate Recall MA	102	54	96	44	30
22 WPPSI Information AE	69	54	78	63	48
23 WPPSI Vocabulary AE	75	51	75	69	42
24 WPPSI Arithmetic AE	81	66	78	72	48
25 WPPSI Similarities AE	84	69	72	78	39
26 WPPSI Comprehension AE	84	51	66	63	39
27 WPPSI Animal-House AE	78	39	72	72	30
28 WPPSI Picture Completion AE	69	45	78	72	42
29 WPPSI Mazes AE	90	75	78	60	36
30 WPPSI Geometric Designs AE	78	57	78	78	48
31 WPPSI Block Design	87	57	78	66	51
32 WPPSI Mean Verbal Subtest AE	79	58	74	69	43
33 WPPSI Mean Performance Subtest AE	80	55	77	70	41
34 WPPSI Mean Full Scale AE	80	56	75	69	42
35 Quick Test 1-2-3 MA	86	27	102	76	40
36 Quick Test 1-2-3 IQ	57	26	68	61	38
37 SIT MA	88	70	90	80	54
38 SIT IQ	59	55	60	64	51
39 PMAT Mean Subtest MA	98	70	96	78	72
40 PMAT Verbal Meaning MA	98	68	86	64	64
41 PMAT Spatial Relations MA	116	82	96	88	72
42 PMAT Number Facility MA	94	72	100	80	72
43 PMAT Perceptual Speed	98	66	96	76	72
44 Composite Predictor Score 1, Total MA	498	295	387	379	288
45 Composite Predictor Score 2, Total MA	367	267	358	308	224
46 Composite Predictor Score 3, Total MA	352	263	367	294	228

Raw Test Data (Continued)

Variable/Subject	1	6	11	16	21
47 Coding Pretest RS	70	43	82	63	18
48 Paired Associate Task Pretest RS	38	18	42	21	8
49 Order Learning Task Pretest RS	41	12	38	28	18
50 Combined Learning Task Score RS	149	73	162	112	44
51 Coding Posttest RS	80	48	86	94	20
52 Paired Associate Task Posttest RS	41	24	39	14	25
53 Order Learning Task Posttest RS	42	18	35	33	30
54 WRAT Reading Pretest RS	48	16	35	40	22
55 WRAT Spelling Pretest RS	33	11	23	33	5
56 WRAT Arithmetic Pretest RS	25	12	23	18	10
57 WRAT Reading Posttest RS	52	23	41	45	9
58 WRAT Spelling Posttest RS	34	15	27	36	4
59 WRAT Arithmetic Posttest RS	26	13	28	25	8
60 NYAT Reading Pretest RS	47	2	23	25	4
61 NYAT Math Pretest RS	9	7	13	10	4
62 NYAT Core Pretest RS	31	17	33	15	9
63 NYAT Reading Posttest RS	65	3	24	34	5
64 NYAT Math Posttest RS	20	8	17	17	1
65 NYAT Core Posttest RS	37	19	34	22	8

Raw Test Data (Continued)

Var./S	22	25	27	30	32	35	37	40	42	45	51
1.	144	144	119	118	84	142	135	115	116	139	80
2.	79	77	65	61	55	52	68	64	60	74	62
3.	59	58	54	52	62	42	54	56	51	57	75
4.	78	57	54	57	40	41	65	64	54	67	54
5.	55	37	60	51	36	64	64	64	42	73	36
6.	108	57	57	62	66	32	105	80	87	57	42
7.	88	88	46	70	46	76	108	76	50	88	82
8.	73	66	44	47	39	24	66	63	59	78	56
9.	72	58	68	55	52	72	61	68	55	68	58
10.	79	68	68	72	31	38	72	68	42	76	53
11.	67	47	41	45	33	25	43	43	43	52	50
12.	78	52	40	65	48	44	65	78	82	69	69
13.	90	51	60	53	31	24	49	57	40	57	51
14.	67	64	65	61	53	57	68	64	61	68	62
15.	46	44	55	52	63	42	51	56	53	49	77
16.	60	72	54	66	51	78	102	69	72	84	50
17	72	42	60	72	75	57	75	54	51	45	80
18.	66	72	60	66	42	44	84	66	60	72	54
19.	66	51	66	57	57	51	60	57	57	69	54
20.	69	84	75	54	42	57	50	69	62	78	86
21.	72	48	72	48	54	54	63	63	63	54	54
22.	63	60	63	54	48	48	57	57	60	69	60
23.	60	48	48	54	48	48	48	57	48	66	63
24.	60	66	66	60	48	57	48	66	57	66	63
25.	78	63	57	63	48	63	78	57	48	108	78
26.	54	57	48	48	51	51	66	60	48	54	51
27.	66	72	78	78	48	81	69	57	63	69	63
28.	75	60	72	78	51	75	69	54	57	72	57
29.	54	54	66	63	48	51	51	54	66	57	63
30.	72	57	78	69	51	72	57	60	66	63	66
31.	63	60	75	75	51	78	66	60	54	60	69
32.	63	59	56	56	49	53	59	59	52	73	63
33.	66	61	74	73	50	71	62	57	61	64	64
34.	65	60	65	64	50	62	61	58	57	68	63
35.	82	90	74	54	40	48	74	66	48	74	66
36.	58	63	62	46	47	34	55	57	41	53	82
37.	76	67	80	61	59	39	61	65	70	72	62
38.	53	47	66	52	70	48	45	56	61	52	77
39.	68	68	73	68	72	72	69	69	73	70	73
40.	64	64	74	64	72	72	82	70	76	62	76
41.	78	72	74	68	72	94	68	68	84	84	84
42.	70	70	72	70	72	72	70	70	70	70	72
43.	60	62	62	68	68	68	68	66	64	70	70
44.	318	307	292	302	266	306	368	332	307	375	284

Raw Test Data (Continued)

Var./S	22	25	27	30	32	35	37	40	42	45	51
45.	272	286	257	231	201	210	234	268	248	292	277
46.	287	226	244	244	238	255	272	255	235	261	263
47.	38	58	64	51	25	94	23	52	63	99	60
48.	17	42	24	3	3	30	3	4	17	31	22
49.	42	28	24	18	40	14	25	29	39	45	29
50.	97	128	112	72	68	138	51	85	119	175	111
51.	58	62	88	77	94	92	29	80	38	108	55
52.	18	40	45	11	6	31	20	25	34	39	29
53.	42	33	22	23	36	25	21	32	34	24	31
54.	15	23	23	16	10	12	13	14	18	24	14
55.	17	11	19	14	2	17	9	13	20	19	9
56.	10	8	12	5	10	14	4	6	11	13	7
57.	23	30	28	22	16	19	12	24	24	29	24
58.	18	12	22	16	7	20	9	17	16	19	12
59.	15	10	22	9	5	16	8	13	23	16	19
60.	3	10	1	1	0	6	1	6	2	5	3
61.	5	6	3	0	1	8	0	3	3	3	2
62.	17	13	21	10	10	19	13	10	9	12	12
63.	7	12	10	8	8	2	8	15	5	7	6
64.	9	10	12	6	7	6	6	6	8	6	5
65.	23	17	29	15	10	27	27	24	21	19	18

Var./S	5	10	15	20	24	29	34	39	44	49	50
1.	135	155	152	84	140	140	121	143	127	134	146
2.	63	94	92	55	63	66	75	64	74	96	92
3.	50	64	64	62	49	51	62	50	59	73	66
4.	45	112	88	40	55	48	70	58	21	89	101
5.	46	82	87	37	55	36	30	55	55	78	108
6.	108	105	87	64	57	75	108	57	75	75	105
7.	60	88	108	46	65	65	108	55	55	65	108
8.	42	99	82	44	59	47	66	70	78	80	108
9.	47	112	76	52	55	36	101	68	72	108	76
10.	53	112	108	46	49	64	72	64	83	107	108
11.	37	112	84	37	37	47	52	47	41	108	61
12.	40	90	99	48	65	36	82	52	86	86	119
13	42	112	68	38	60	57	57	51	108	74	90
14.	56	92	103	47	62	61	81	57	59	101	80
15.	42	63	72	57	44	43	67	40	46	75	54
16.	66	96	102	30	96	102	94	66	78	108	84
17.	51	102	108	48	51	48	72	45	51	108	72
18.	42	90	72	42	63	63	90	54	57	96	102

Raw Test Data (Continued)

Var./S	5	10	15	20	24	29	34	39	44	49	50
19.	57	60	99	48	51	51	69	72	54	72	78
20.	66	108	108	48	63	62	81	62	57	96	75
21.	48	102	108	72	48	48	102	36	63	108	72
22.	54	90	78	54	60	60	78	75	69	78	108
23.	48	72	75	48	54	54	51	48	60	78	108
24.	54	90	78	54	66	60	72	66	72	108	78
25.	57	92	78	48	69	66	78	54	78	78	66
26.	48	90	75	54	51	57	48	51	108	63	60
27.	48	87	73	57	72	66	78	48	108	108	108
28.	51	90	78	51	57	60	72	51	48	108	108
29.	48	84	78	51	48	54	66	54	108	108	108
30.	60	87	75	51	63	60	78	66	60	108	75
31.	54	84	78	54	63	63	75	57	54	108	75
32.	52	87	77	52	60	59	65	59	77	81	84
33.	52	86	76	53	61	61	74	55	76	108	95
34.	52	87	77	52	60	60	70	57	77	95	89
35.	27	87	81	52	78	84	78	72	39	102	84
36.	20	56	54	60	56	60	62	50	31	76	57
37.	69	96	86	55	66	57	69	68	81	98	94
38.	52	66	58	62	47	45	54	47	63	73	64
39.	71	99	96	71	73	66	76	65	78	98	94
40.	58	92	92	74	74	58	78	60	76	98	98
41.	74	100	94	70	82	70	96	72	94	116	94
42.	72	100	100	72	70	72	74	70	80	94	80
43.	70	98	98	60	72	62	74	58	66	98	94
44.	296	475	469	243	352	319	338	319	357	458	442
45.	236	397	366	218	258	241	293	268	287	378	341
46.	212	413	366	216	235	203	313	253	281	390	336
47.	40	106	94	15	69	16	37	6	98	67	109
48.	12	43	26	2	25	9	40	33	13	38	45
49.	35	39	39	7	35	22	45	17	24	32	35
50.	87	188	159	24	159	47	122	56	135	137	192
51.	57	161	75	19	88	23	95	10	93	115	139
52.	23	47	26	3	39	8	10	23	34	45	45
53.	38	42	30	10	34	20	42	30	33	39	38
54.	10	31	30	5	25	11	26	28	28	37	48
55.	10	25	24	6	17	21	20	13	22	28	31
56.	8	24	28	3	9	8	15	11	14	28	16
57.	16	39	31	7	26	18	26	31	35	44	52
58.	8	29	26	6	18	17	20	10	28	34	34
59.	12	28	28	3	10	8	18	14	24	29	18
60.	4	27	33	0	1	2	4	8	12	53	28
61.	4	14	12	0	6	5	1	4	8	13	10
62.	7	37	27	5	18	7	23	9	25	27	30
63.	6	39	34	3	3	4	3	10	23	67	42
64.	5	23	24	4	6	4	9	7	15	20	21
65.	12	37	34	12	23	23	33	12	29	36	36

Raw Test Data (Continued)

Var./S	2	7	12	17	23	28	33	38	43	46	48
1.	112	102	122	100	148	125	131	80	147	152	106
2.	67	72	64	54	78	57	62	62	70	88	62
3.	58	68	53	52	57	47	53	75	52	62	56
4.	59	68	51	48	64	55	62	54	55	87	62
5.	46	69	36	33	46	51	69	37	46	82	73
6.	57	44	40	49	66	57	57	40	53	87	62
7.	70	82	38	38	70	42	60	82	82	95	82
8.	66	78	50	39	70	53	59	53	53	87	56
9.	68	52	52	50	58	52	58	58	58	81	58
10.	46	76	46	64	76	64	108	49	76	108	76
11.	43	94	41	52	67	55	33	50	37	88	41
12.	90	73	73	78	78	52	73	69	48	82	40
13.	55	60	71	38	53	57	60	51	53	77	77
14.	63	73	59	58	69	56	62	72	60	97	67
15.	58	71	48	58	46	45	47	92	41	64	63
16.	66	63	60	84	78	66	72	51	66	72	78
17.	57	90	42	42	48	54	60	102	45	108	54
18.	57	63	52	42	54	46	66	72	48	96	96
19.	60	69	60	57	108	54	54	57	39	108	69
20.	81	75	72	57	81	52	62	96	66	81	64
21.	48	96	72	102	54	72	42	54	54	96	42
22.	60	63	57	48	63	51	57	60	57	90	54
23.	48	75	54	48	63	51	60	60	60	90	60
24.	60	66	66	57	66	60	72	66	32	75	54
25.	78	78	54	51	69	57	51	78	54	69	51
26.	54	60	48	48	60	60	60	48	48	81	48
27.	63	60	63	54	60	57	57	63	78	81	72
28.	54	57	63	54	63	54	54	57	72	81	69
29.	57	48	60	51	54	48	48	66	60	90	54
30.	69	66	66	57	63	51	60	66	66	93	66
31.	63	78	54	54	63	51	54	69	63	90	75
32.	60	68	56	50	64	56	60	62	50	81	53
33.	60	62	61	54	61	52	67	64	67	87	67
34.	60	65	59	52	62	54	63	63	59	84	60
35.	66	72	48	27	70	48	72	66	50	84	63
36.	59	70	39	26	47	39	55	82	34	55	59
37.	79	78	64	52	82	63	65	65	64	96	68
38.	70	75	52	53	55	51	50	81	44	62	64
39.	73	74	73	70	73	62	71	75	73	89	70
40.	64	76	66	66	72	58	72	78	76	86	70
41.	80	84	76	72	72	66	76	94	84	142	70
42.	72	72	70	72	74	70	70	70	72	92	72
43.	76	72	72	68	90	58	64	72	64	76	66
44.	326	354	288	296	358	298	334	283	301	409	345
45.	279	291	258	225	291	235	263	285	223	335	246

Raw Test Data (Continued)

Var./S	2	7	12	17	23	28	33	37	43	46	48
46.	263	292	214	203	250	229	247	283	228	368	240
47.	31	41	47	26	43	17	34	68	71	96	61
48.	23	20	4	15	21	7	30	25	26	32	29
49.	32	38	22	37	32	21	14	42	16	41	38
50.	86	99	73	78	96	45	78	135	113	169	128
51.	51	56	76	47	53	17	58	33	63	109	52
52.	30	33	11	19	22	10	42	36	38	35	40
53.	37	36	25	35	35	30	10	41	24	38	27
54.	23	28	12	25	28	11	14	19	27	37	24
55.	19	17	15	9	21	8	15	10	22	25	14
56.	11	14	12	12	16	10	12	10	14	25	15
57.	28	30	22	25	35	7	23	28	28	45	29
58.	24	22	19	10	19	10	14	18	19	26	26
59.	16	22	16	12	17	9	16	19	14	28	20
60.	3	0	5	5	5	1	4	2	10	29	1
61.	0	3	4	6	8	2	4	1	7	11	3
62.	9	13	14	3	18	10	22	9	17	28	6
63.	5	9	6	12	10	2	5	8	11	34	11
64.	4	12	5	5	16	4	8	4	7	17	8
65.	13	25	21	13	24	11	23	21	20	35	24

Var./S	4	9	13	14	18	19	26	31	36	41	47
1.	116	100	118	123	136	117	143	102	131	139	86
2.	62	64	61	78	63	63	77	68	81	68	65
3.	53	62	51	63	50	53	58	64	63	53	73
4.	58	67	47	88	57	52	69	55	85	63	68
5.	37	55	42	60	55	60	78	51	114	46	46
6.	108	94	49	94	94	62	59	75	80	87	57
7.	82	70	50	108	50	50	82	50	95	70	95
8.	47	78	50	82	44	53	82	50	73	53	56
9.	52	68	44	108	61	52	58	68	68	61	64
10.	68	79	52	108	49	76	68	68	110	68	107
11.	50	36	43	67	39	50	84	31	61	58	50
12.	56	61	40	90	82	36	65	86	64	90	90
13.	51	95	40	68	55	49	60	44	108	49	74
14.	52	59	61	103	70	56	75	67	79	68	65
15.	45	59	48	84	52	47	52	67	59	49	75
16.	63	69	42	96	66	63	90	78	108	84	72
17.	36	48	48	108	75	48	75	60	66	51	57
18.	54	54	45	96	72	57	66	57	72	57	54
19.	60	54	48	90	69	48	69	87	100	66	60
20.	36	60	48	102	69	64	69	66	81	75	66

Raw Test Data (Continued)

Var./S	4	9	13	14	18	19	26	31	36	41	47
21.	72	96	52	108	63	48	105	48	54	84	75
22.	57	69	54	78	54	51	75	69	75	57	63
23.	60	48	57	78	36	48	78	72	78	54	66
24.	60	60	60	108	72	60	66	72	60	75	66
25.	57	66	60	72	69	63	78	57	78	72	69
26.	57	60	48	108	48	51	78	54	82	54	48
27.	60	66	57	78	72	66	78	60	78	66	54
28.	63	78	60	108	75	63	69	69	80	54	60
29.	54	48	51	108	78	63	51	63	78	54	57
30.	63	54	63	108	69	63	72	60	66	63	63
31.	54	63	54	108	78	63	78	75	69	60	54
32.	58	61	56	89	56	55	75	65	75	62	62
33.	59	62	57	102	74	64	70	65	74	59	58
34.	59	61	56	95	65	59	72	65	74	61	60
35.	69	82	64	72	75	62	82	68	96	79	77
36.	59	82	49	57	55	48	58	65	72	57	90
37.	67	63	57	82	67	67	88	66	73	70	64
38.	58	63	49	66	47	57	61	65	56	50	74
39.	71	72	67	86	78	72	80	78	80	74	72
40.	74	72	64	72	84	68	74	76	86	66	58
41.	72	72	72	124	82	72	84	80	100	74	72
42.	70	72	70	76	72	72	76	70	72	74	72
43.	70	72	58	96	74	74	114	80	74	80	72
44.	287	336	262	410	311	322	440	329	441	337	318
45.	313	270	228	368	257	249	293	258	286	277	260
46.	205	266	212	374	252	225	291	248	279	239	249
47.	60	21	47	52	60	20	55	74	83	61	24
48.	22	40	12	42	38	6	20	13	39	32	9
49.	32	38	12	42	40	31	41	43	37	40	39
50.	114	99	71	94	138	57	116	130	159	133	72
51.	97	58	47	80	65	47	64	75	142	63	43
52.	42	40	13	42	42	26	20	31	38	37	17
53.	36	35	15	35	37	26	40	40	32	35	40
54.	14	25	12	48	16	21	26	10	28	35	24
55.	17	12	11	33	20	19	17	20	18	20	12
56.	7	8	4	25	17	10	22	9	15	19	10
57.	25	26	18	32	21	26	29	21	27	37	25
58.	17	20	11	24	21	24	21	15	22	27	12
59.	12	8	5	28	22	14	26	13	22	17	14
60.	0	0	0	11	7	5	5	1	4	7	2
61.	0	1	1	11	7	6	6	1	8	11	4
62.	12	6	7	17	20	12	27	9	29	17	7
63.	3	9	1	18	4	3	17	8	15	10	8
64.	5	4	3	21	11	7	10	5	9	17	9
65.	22	14	8	32	32	16	31	27	28	23	16

Raw Test Data (Continued)

Var./S	3	8
1.	138	117
2.	90	68
3.	67	59
4.	71	62
5.	82	36
6.	70	66
7.	76	50
8.	99	59
9.	81	81
10.	93	72
11.	67	67
12.	73	73
13.	90	57
14.	97	62
15.	71	53
16.	108	102
17.	78	39
18.	60	44
19.	108	60
20.	120	75
21.	108	78
22.	78	60
23.	78	57
24.	78	78
25.	72	57
26.	78	72
27.	78	69
28.	78	69
29.	78	72
30.	78	78
31.	78	57
32.	77	65
33.	78	69
34.	78	67
35.	86	48
36.	61	41
37.	96	78
38.	69	67
39.	97	78
40.	92	70
41.	96	84
42.	100	72
43.	98	86
44.	487	355
45.	397	284

Raw Test Data (Continued)

Var./S	3	8
46.	358	251
47.	127	34
48.	41	16
49.	36	42
50.	204	92
51.	199	57
52.	41	19
53.	42	40
54.	38	26
55.	30	20
56.	28	14
57.	39	28
58.	29	16
59.	27	23
60.	51	5
61.	13	6
62.	31	22
63.	66	17
64.	17	11
65.	34	20

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ABSTRACT

This study was designed to evaluate the combination of specific subtests as predictors of achievement with institutionalized educable mentally handicapped children at three age levels. Six individually administered tests, one test suitable for group administration , and three learning tasks were used to determine the utility of a battery or partial battery approach when compared to the single channel or global score prediction of achievement. Tests used as predictors were the Stanford-Binet, Illinois Test of Psycholinquistic Abilities, Pictorial Test of Intelligence, Wechsler Preschool and Primary Scale of Intelligence, Quick Test, Slosson Intelligence Test, and the Primary Mental Abilities Test. Learning tasks included as predictor measures were the Coding subtest from the WISC, a paired associate task, and an order learning task. Multiple criteria of gain scores on the Wide Range Achievement Test and the New York Achievement Test subtests were used as criterion measures of overall, arithmetic, and reading achievement.

The sample included 51 institutionalized, educable mentally retarded children between the ages of 6-7 and 12-6. All subjects received a total pretest battery of six individual tests and one group test and pre and posttesting on the three learntasks and the criterion achievement measures. Correlation, multiple regression, and factor analyses of the data were made.

The validity coefficients of the predictor measures with the overall achievement criterion, with the exception of the Quick Test and the Primary Mental Abilities Test, were not significantly different. Differences in test validities of the same tests used a various age levels were substantiated. Learning tasks yielded low to moderate validity coefficients when compared to the criterion measures.